

GAO Highlights

Highlights of [GAO-18-610](#), a report to congressional requesters

Why GAO Did This Study

The Great Lakes-Seaway system extends 2,300 miles and serves more than 100 ports in the United States and Canada. Four of the 17 locks that enable navigation are managed by the Army Corps (within the Department of Defense) and U.S. Seaway Corporation (within the Department of Transportation). The rest are managed by Canada. A 2007 U.S.-Canada study noted the system could absorb additional traffic and led to U.S. asset renewal plans to improve lock infrastructure condition.

GAO was asked to review efforts to modernize the Great Lakes-Seaway. This report examines (1) shipping trends since 1980 and factors affecting recent trends, (2) stakeholder views on challenges to use, and (3) the extent to which the Army Corps and the U.S. Seaway Corporation have made progress on and measure performance of lock renewal efforts. GAO analyzed Seaway and Army Corps shipping data from 1980 through 2016, the agencies' asset renewal plans, and interviewed 24 stakeholders, including port and shipper representatives, selected to represent a range of perspectives.

What GAO Recommends

GAO recommends that (1) the U.S. Seaway Corporation establish a process to identify, analyze, and monitor risks to the system's use to inform future actions, and (2) the Army Corps develop and adopt goals and measures to assess the performance of the Soo Locks and assess of asset renewal outcomes. The Departments of Transportation and Defense concurred with our recommendations and provided technical comments which we incorporated as appropriate.

View [GAO-18-610](#). For more information, contact Susan Fleming at (202) 512-2834 or flemings@gao.gov.

September 2018

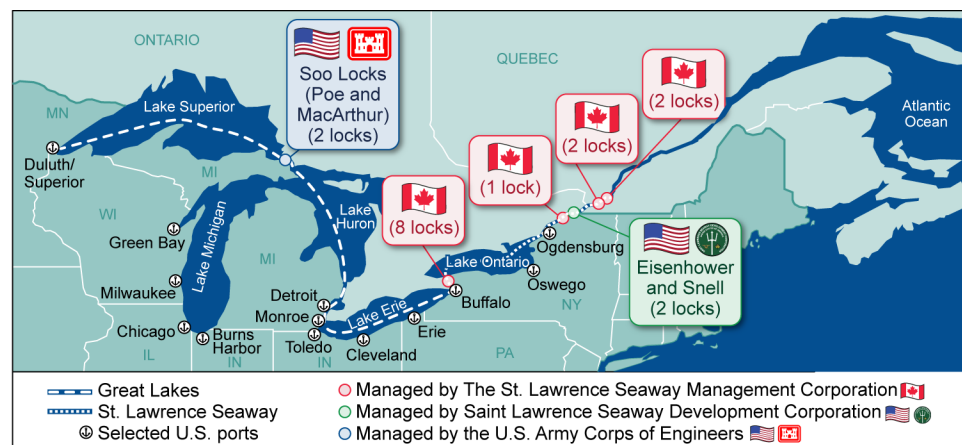
GREAT LAKES-ST. LAWRENCE SEAWAY

Assessing Risks and Measuring Performance Could Improve Maritime Transportation

What GAO Found

The tons of cargo moved by domestic Great Lakes and St. Lawrence Seaway traffic have declined since 1980—by 32 and 48 percent, respectively, according to U.S. Army Corps of Engineers (Army Corps) and Saint Lawrence Seaway Development Corporation (U.S. Seaway Corporation) data. Stakeholders identified various factors for this decrease such as the U.S. economy's shift away from manufacturing. Traffic on the Great Lakes-St. Lawrence Seaway (Great Lakes-Seaway) is traditionally dominated by bulk commodities like iron ore, although stakeholders noted emerging uses like containerized cargo and cruises.

The Great Lakes- St. Lawrence Seaway Navigation System



Sources: GAO and Map Resources. | GAO-18-610

Stakeholders identified a range of challenges to using the Great Lakes-Seaway—such as inadequate portside infrastructure for intermodal transfers of shipping containers—that together pose risks for both traditional bulk cargos and emerging uses. Although the U.S. Seaway Corporation's mission is to improve the system's utilization and reliability, the Corporation has not fully assessed the risks that challenges pose to the system's users. Establishing a process to assess and monitor risks, in accordance with federal internal control standards, would help inform future actions to address identified and emerging challenges.

The U.S. Seaway Corporation and the Army Corps have made progress on lock asset renewal efforts, but the Army Corps lacks goals and measures to assess performance and outcomes of these efforts. According to estimates provided by the Army Corps, it has completed 18 projects totaling about \$53 million to date, and has about \$257 million in remaining and ongoing work through 2035. Meanwhile, the U.S. Seaway Corporation has completed 16 projects totaling \$45 million and has almost \$144 million in remaining and ongoing work through 2023. The Army Corps has not developed goals and measures to assess its asset renewal results, as the U.S. Seaway Corporation has done. As a result, the Army Corps lacks tools to assess the outcomes of these efforts and demonstrate the extent to which its asset renewal efforts have improved operational performance of the Soo Locks.

Contents

Letter		1
	Background	6
	Great Lakes-Seaway Cargo Levels Have Decreased since 1980 due to Various Economic Factors but Selected Stakeholders Report Recent Increased Diversity of Uses	11
	Selected Stakeholders Identified Various Challenges to Using the Great Lakes-Seaway, but the U.S. Seaway Corporation Has Not Fully Assessed Risks	18
	The U.S. Seaway Corporation and the Army Corps Have Made Progress on Lock Asset Renewal Efforts, but the Army Corps Lacks Associated Goals and Measures	28
	Conclusion	37
	Recommendations for Executive Action	38
	Agency Comments	38
Appendix I	Objectives, Scope, and Methodology	40
Appendix II	List of Asset Renewal Projects	43
Appendix III	Comments from the Department of Transportation	48
Appendix IV	Comments from the Department of Defense	49
Appendix V	GAO Contact and Staff Acknowledgments	52
Tables		
	Table 1: Saint Lawrence Seaway Development Corporation's (U.S. Seaway Corporation) and U.S. Army Corps of Engineers' (Army Corps) Progress on Key Asset Renewal Projects Identified in 2007, as of 2018	33
	Table 2: U.S. Army Corps' Asset Renewal Projects for the Soo Locks (Note: Costs Are Estimates)	43

Table 3: Saint Lawrence Seaway Development Corporation (U.S. Seaway Corporation) Asset Renewal Projects	45
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Figures

Figure 1: The Great Lakes- St. Lawrence Seaway Navigation System	2
Figure 2: Operation of a Lock	4
Figure 3: Domestic Great Lakes and St. Lawrence Seaway Cargo Traffic (1980–2016), Millions of Tons	12
Figure 4: Domestic Great Lakes Cargo Traffic for Key Commodities, 2001–2016, Millions of Tons	13
Figure 5: St. Lawrence Seaway Cargo Traffic for Key Commodities, 2001–2016, Millions of Tons	14
Figure 6: The Poe Lock, Located at Sault Ste. Marie, Michigan, and Managed by the U.S. Army Corps of Engineers	21
Figure 7: Illustration of a Lock and Its Selected Components	30
Figure 8: Total Asset Renewal Cost Estimate by Project Status as of 2018 for U.S. Army Corps of Engineers (Army Corps) through 2035 and U.S. Saint Lawrence Seaway Corporation (U.S. Seaway Corporation) through 2023	32
Figure 9: U.S. Army Corps of Engineers (Army Corps) and U.S. Saint Lawrence Seaway Corporation (U.S. Seaway Corporation) Funding Received for Asset Renewal Efforts, Fiscal Years 2008–2017 (in millions)	35

Abbreviations

Army Corps	U.S. Army Corps of Engineers
Canadian Seaway Corporation	St. Lawrence Seaway Management Corporation
EPA	Environmental Protection Agency
Great Lakes-Seaway	Great Lakes-St. Lawrence Seaway navigation system
U.S. Seaway Corporation	Saint Lawrence Seaway Development Corporation

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September 5, 2018

The Honorable John Barrasso, M.D.
Chairman
Committee on Environment and Public Works
United States Senate

The Honorable Bill Shuster
Chairman
The Honorable Peter DeFazio
Ranking Member
Committee on Transportation and Infrastructure
House of Representatives

The Honorable James M. Inhofe
United States Senate

The Honorable Gary C. Peters
United States Senate

Since 1959, the Great Lakes-St. Lawrence Seaway (Great Lakes-Seaway) navigation system has provided an important transportation route to the manufacturing and agricultural heartland of North America. The Great Lakes-Seaway extends 2,300 miles from Duluth, Minnesota to the Atlantic Ocean and serves more than 100 ports in eight U.S. states and two Canadian provinces (see fig. 1). In 2007, a joint U.S.-Canadian study¹ found that the Great Lakes-Seaway was operating at about half of its potential capacity and could absorb additional traffic. Further, in 2016 the Congressional Research Service reported that U.S. domestic cargo volume within the Great Lakes was about half that of the 1950s and 1960s.² The 2007 study also led to U.S. asset renewal plans to improve the system's lock infrastructure condition—at the time, the first coordinated effort to assess and improve the system's infrastructure in its 50 year existence. Now over a decade after the 2007 report and almost

¹Transport Canada, U.S. Army Corps of Engineers, U.S. Department of Transportation, The St. Lawrence Seaway Management Corporation, Saint Lawrence Seaway Development Corporation, Environment Canada, and U.S. Fish and Wildlife Service, *Great Lakes St. Lawrence Seaway Study* (Fall 2007).

²See Congressional Research Service, *The Great Lakes-St. Lawrence Seaway Navigation System: Options for Growth* (Oct. 26, 2016).

60 years since the opening of the system, the Great Lakes-Seaway's potential as America's "fourth coast" remains, as it provides direct access to a region that is home to 107 million people, including major cities such as Chicago, Detroit, Cleveland, and Toronto.

Figure 1: The Great Lakes- St. Lawrence Seaway Navigation System



Sources: GAO and Map Resources. | GAO-18-610

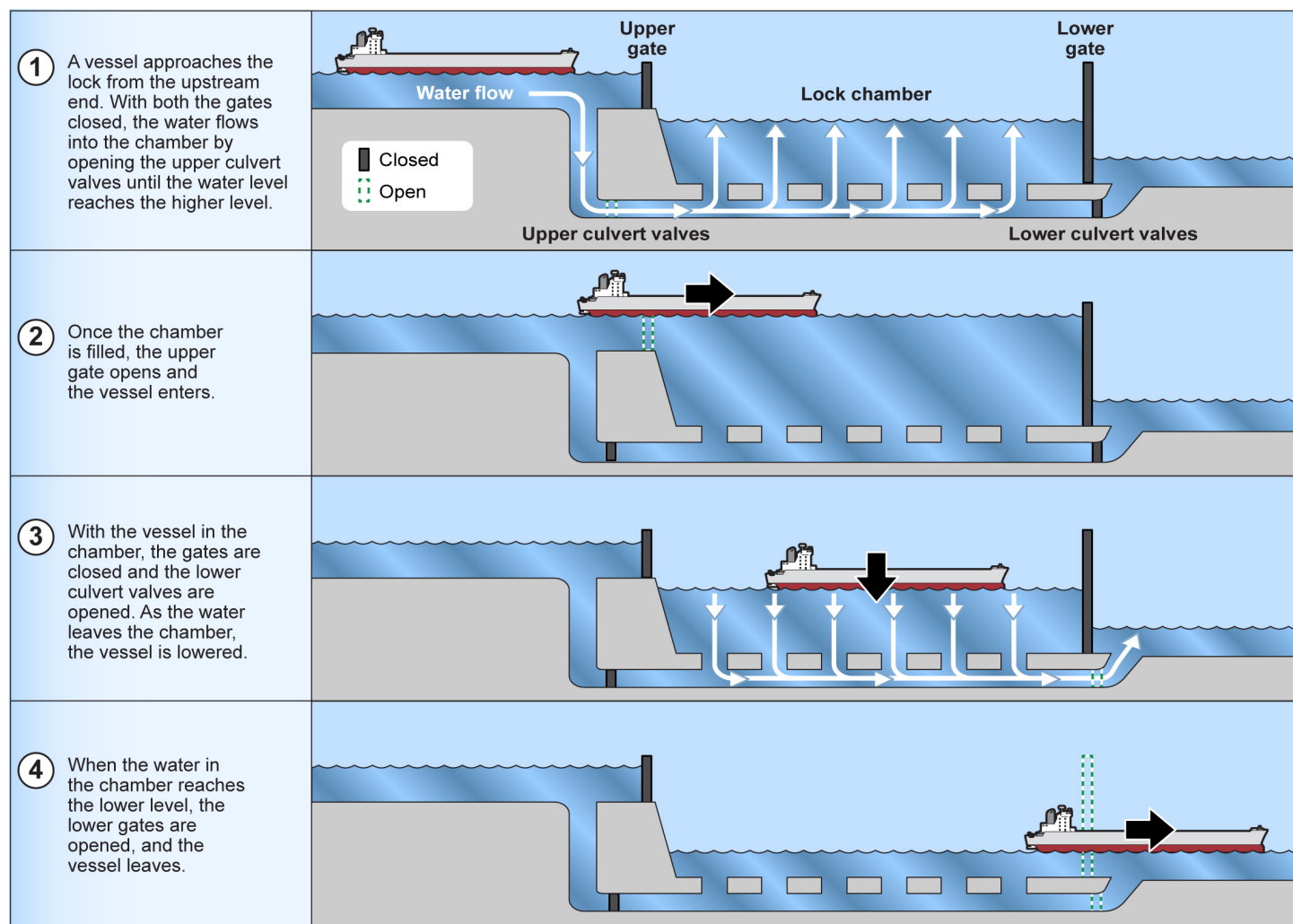
The Great Lakes-Seaway has been managed jointly between the U.S. and Canada throughout its history. A series of 17 locks enables commercial vessels to navigate a change in elevation of over 600 feet between the Atlantic Ocean and Lake Superior.³ The primary purpose of a lock is to raise and lower vessels to bypass river rapids or overcome changes in water levels (see fig. 2 for how a lock operates). The 17 locks are divided between U.S. and Canadian management, with 4 locks managed by two U.S. federal agencies. Specifically, the Saint Lawrence

³To navigate the entire system, vessels must navigate a total of 16 locks. This is because two of the locks (the Soo locks) are parallel, meaning the ship must only navigate one of the two locks.

Seaway Development Corporation (U.S. Seaway Corporation) manages 2 locks in Massena, New York, that are located among the 13 locks that are managed by Canada's St. Lawrence Seaway Management Corporation (Canadian Seaway Corporation).⁴ Meanwhile the U.S. Army Corps of Engineers (Army Corps) manages the Soo locks—two parallel locks in Sault Ste. Marie, Michigan, that connect Lake Superior with the rest of the Great Lakes. In addition to its binational management, another critical feature of the Great Lakes-Seaway is that the system is closed to navigation for 2 to 3 months in the winter due to weather conditions and in order to complete maintenance on the locks.

⁴To make the distinction clear between the U.S. Saint Lawrence Seaway Development Corporation and the Canadian St. Lawrence Seaway Management Corporation, we refer to them as the "U.S. Seaway Corporation" and the "Canadian Seaway Corporation" throughout this report.

Figure 2: Operation of a Lock



Source: GAO. | GAO-18-610

You asked us to review efforts to modernize the Great-Lakes Seaway. This report examines (1) how Great Lakes-Seaway shipping trends have changed since 1980 and what factors have shaped recent trends, (2) selected stakeholders' perspectives on challenges to using the Great Lakes-Seaway, and (3) to what extent Army Corps and the U.S. Seaway Corporation have made progress on lock infrastructure renewal efforts and how the agencies measure performance of these efforts.

To understand shipping trends, we analyzed cargo traffic by tonnage from 1980 to 2016 for the St. Lawrence Seaway (published by the Canadian and U.S. Seaway Corporations) and for domestic cargo traffic on the Great Lakes (from the Army Corps' Waterborne Commerce Statistics Center). Although the Seaway data represent all cargo traffic that travels on the St. Lawrence Seaway, the Army Corps data we analyzed exclusively represent traffic between U.S. ports on the Great Lakes system. As a result, some cargos that travel on the Great Lakes—such as between Canadian ports or U.S. and Canadian ports—are not included in this report. We selected the 1980 to 2016 timeframe to describe long-term trends using data that both sources collected consistently, and since 2016 was the most recent year available from both data sources. We also analyzed recent cargo traffic trends for the top five commodities that comprised domestic Great Lakes and St. Lawrence Seaway cargo traffic by tonnage from 2001 to 2016. These years were selected to represent the past approximately 15 years of traffic. We assessed the data's reliability by reviewing documentation and interviewing Army Corps and U.S. and Canadian Seaway Corporation officials and determined the data were sufficiently reliable for our purpose of describing trends.

To obtain selected stakeholders' perspectives on factors shaping recent trends and challenges, we interviewed 24 stakeholders, including industry associations, carriers (companies that transport goods), shippers (companies that own the transported goods), ports, maritime transportation experts, and regional and maritime stakeholder groups. Stakeholders were selected to represent a range of types of traffic (such as U.S. vessels travelling within the Great Lakes and foreign ocean-going vessels) and a range in use of the system (shipping of traditional bulk goods as well as emerging uses such as containers and cruises). We grouped the challenges identified by stakeholders based on whether they affect traditional use of the system or emerging use of the system. Although the results are non-generalizable, stakeholders were selected to represent a range of known perspectives.

To understand the U.S. Seaway Corporation's and Army Corps' progress on asset renewal efforts and how they measure performance of these efforts, we analyzed available information on asset renewal projects, their

status, and estimated cost from both agencies.⁵ We also reviewed U.S. Seaway Corporation's and Army Corps' relevant reports, asset renewal plans, and documentation related to program goals and performance measures, such as annual financial and performance reports, from 2007 through 2018 and interviewed officials from both agencies. We compared agencies' efforts to GAO's *Standards for Internal Control in the Federal Government* and *Leading Practices in Capital Decision-Making*.⁶ We did not evaluate the Canadian agencies responsible for overseeing Canadian-managed Seaway locks. For more information on our scope and methodology, see appendix I.

We conducted this performance audit from June 2017 to September 2018 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

The Great Lakes-Seaway system's commercial shipping has traditionally been dominated by vessels carrying bulk commodities such as grain, coal, and iron ore, although there are differences between the shipping on the Great Lakes versus the St. Lawrence Seaway portions of the system. On the Great Lakes side, U.S.-flag (meaning registered in the United States) vessels are primarily "lakers"—meaning they stay on the Great Lakes and generally do not enter the St. Lawrence Seaway. This domestic Great Lakes traffic primarily consists of iron ore, limestone, and coal that are transported to serve the U.S. steelmaking industry. For example, U.S. lakers transport iron ore, mined in northern Minnesota, from Duluth to steel manufacturers at ports such as Burns Harbor, Indiana, and Toledo, Ohio, in the lower Great Lakes. U.S. law requires

⁵Although we describe the agencies' cost estimates for their asset renewal efforts, it was beyond the scope of this engagement to check these cost estimates for accuracy and completeness. Likewise, although we describe the agencies' processes for selecting projects for funding, we did not verify these processes by, for example, selecting projects and ensuring the selection met the agencies' established procedures for selection.

⁶See GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014) and *Executive Guide: Leading Practices in Capital Decision-Making*, [GAO/AIMD-99-32](#) (Washington, D.C.: December 1998).

that maritime transport of cargo between U.S. ports be carried by U.S.-flag vessels.⁷

In contrast to the Great Lakes, the St. Lawrence Seaway is used primarily by Canadian- or foreign-flag vessels that carry cargo between and among U.S., Canadian, and overseas ports. For example, in 2015, 40 percent of St. Lawrence Seaway traffic, as measured by tonnage moved, consisted of cargos shipped between Canadian ports. Another 34 percent of 2015 Seaway traffic consisted of cross-border trade between U.S. and Canadian ports. Only 10 percent of Seaway traffic in 2015 was between overseas and U.S. ports.⁸ This trade is generally characterized as “steel in/ grain out”—with imported iron and steel products entering the system destined for U.S. ports and U.S. grain leaving the system destined for overseas ports. For example, foreign vessels transport fabricated steel through the Seaway to manufacturing facilities in the Great Lakes region and then carry grain from the region back through the Seaway to overseas destinations such as Europe.

The Great Lakes and St. Lawrence Seaway portions of the system also differ in how they are managed. On the St. Lawrence Seaway, which opened in 1959, the U.S. Seaway Corporation manages the Snell and Eisenhower locks, which are located in Massena, New York. Like all locks on the St. Lawrence Seaway, the Snell and Eisenhower are single locks without parallel locks for redundancy and are the same dimensions—about 766 feet long and 80 feet wide. On the Great Lakes, the Army Corps manages the Soo locks, which consist of two parallel locks: the larger Poe lock, completed in 1968 (1,200 feet long and 110 feet wide) and the smaller MacArthur lock, completed in 1943 (800 feet long and 80 feet wide). Many U.S.-flag laker vessels are restricted to using the Poe lock, as they are too large to fit in the MacArthur lock.

The construction of a second Poe-sized lock at the Soo locks is currently under consideration. In 1986, Congress authorized the construction of a second Poe-sized lock, but funds sufficient to begin construction were never appropriated.⁹ In 2005, the Army Corps calculated a benefit-cost

⁷Section 27 of the Merchant Marine Act of 1920, Pub. L. No. 66-261, 41 Stat. 988, 999 (1920) (codified as amended at 46 U.S.C. § 55102).

⁸The remaining 16 percent consisted of traffic between Canadian and overseas ports.

⁹Water Resources Development Act of 1986, Pub. L. No. 99-662, § 1149, 100 Stat. 4082, 4254. According to the Army Corps, it has received around \$32 million for projects related to construction of a replacement lock.

ratio of 0.73 associated with the construction of a second Poe-sized lock, which was not high enough to request funding.¹⁰ In January 2016, the Army Corps initiated an economic reevaluation of the project's benefit-cost ratio to update assumptions of the 2005 study.¹¹ In July 2018, the Army Corps released its reevaluation study, which estimated the cost of constructing a new Poe-sized lock to be approximately \$922 million with an updated benefit-cost ratio of 2.42.¹² According to the Army Corps, the project will compete with other construction projects throughout the country through the agency's budgeting process. The decision to fund the new lock also involves review by the Office of Management and Budget for inclusion in the President's budget, and Congress will need to appropriate funds.

The U.S. Seaway Corporation and Army Corps also differ in their size and role, for example:

- *The U.S. Seaway Corporation.* In addition to managing the two U.S.-operated locks on the St. Lawrence Seaway, the U.S. Seaway Corporation has a role in enhancing utilization of the entire Great Lakes- Seaway system. Its stated mission is to improve the operation and maintenance of a safe, reliable, and efficient waterway and to perform economic and trade development activities with the aim of enhancing utilization.¹³ In doing so, the Corporation works closely with its Canadian counterpart (the Canadian Seaway Corporation) to

¹⁰The Army Corps uses a project's benefit-cost ratio as a principle metric in determining what projects to recommend for funding. Generally, projects must have a ratio of at least 1 (that is, estimated benefits greater than the estimated costs) for the Army Corps to recommend construction. For more information on the Army Corps' budget process, see *GAO Army Corps of Engineers: Budget Formulation Process Emphasizes Agencywide Priorities, but Transparency of Budget Presentation Could Be Improved*, [GAO-10-453](#) (Washington, D.C.: Apr. 2, 2010).

¹¹Because the Army Corps conducted its economic reevaluation during the course of our review, we did not evaluate its methodology or assumptions as part of this report.

¹²The Army Corps' benefit-cost ratio of 2.42 is based on the current federal discount rate for water resource projects of 2.75 percent. The discount rate is used to convert future benefits and costs into present values. Guidelines established by the Office of Management and Budget state that benefit-cost analyses of proposed investments should use a discount rate of 7 percent. According to the Army Corps, using that discount rate, the new Poe-sized lock has a benefit-cost ratio of 2.32. See Office of Management and Budget, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, Circular A-94 Revised (Washington, D.C.: Oct. 29, 1992).

¹³See Saint Lawrence Seaway Development Corporation's Fiscal Year 2016 Annual Report.

manage the binational St. Lawrence Seaway and provide information on the system to potential users. The U.S. Seaway Corporation is located within the U.S. Department of Transportation and has approximately 140 employees.

- *The Army Corps.* The Army Corps, located within the Department of Defense, maintains a wide range of water resources projects across the country—including the Soo locks—under its Civil Works Program. These projects include over 200 inland waterway locks, such as those along the Mississippi river and its tributaries. The Army Corps' Civil Works Program is supported by approximately 22,000 civilian employees and is organized into three tiers: a national headquarters in Washington, D.C., eight regional divisions, and 38 local district offices. The Detroit District, which is responsible for the day-to-day maintenance and operation of the Soo locks, falls under the Great Lakes and Ohio River Division.

Following the 2007 joint U.S.-Canadian study, the Army Corps and the U.S. Seaway Corporation developed asset renewal plans, which were originally intended to cover approximately 10 years and which focused on replacing or rehabilitating existing lock components to avoid unexpected lock closures.¹⁴ Both agencies complete routine maintenance and capital improvements on the locks during the 2–3 winter months the locks are closed to navigation every year due to weather conditions.

Congress appropriates funding for both Army Corps' and U.S. Seaway Corporation's lock operations and maintenance from the Harbor Maintenance Trust Fund (trust fund).¹⁵ The trust fund is supported through collections of the Harbor Maintenance Tax¹⁶ (also sometimes called a fee¹⁷), which is charged to vessels carrying U.S. domestic or imported cargo or passengers, primarily at coastal and Great Lakes

¹⁴We have previously reported on the U.S. Seaway Corporation's asset renewal plan. See GAO, *St. Lawrence Seaway: Estimates for the Asset Renewal Program Will Change, and Implementing Best Practices May Improve the Estimates' Reliability*, [GAO-10-541R](#) (Washington, D.C.: May 13, 2010).

¹⁵26 U.S.C. § 9505. This is different for the Canadian-managed Seaway locks, which charge tolls to commercial vessels. These tolls are a key source of funding for operations and maintenance of the Canadian locks.

¹⁶26 U.S.C. § 4461.

¹⁷See, e.g., 19 C.F.R. § 24.24.

ports.¹⁸ Congress also appropriates funds from the trust fund for other Great Lakes-Seaway purposes, including dredging (underwater debris removal) to maintain the depth of ports and channels for navigation. In the U.S. portions of the Great Lakes-Seaway, including ports and channels, dredging is primarily conducted by the Army Corps and to a lesser extent the U.S. Seaway Corporation. As of July 2013, the trust fund built up a balance of \$8.5 billion. In 2014, Congress authorized targets to annually increase appropriations from the fund to reduce the balance, and required the Army Corps to allocate annually a minimum amount of funds for the Great Lakes-Seaway system.¹⁹

Two federal agencies within the Department of Homeland Security also have roles in the Great Lakes-Seaway. The U.S. Coast Guard ensures safety in various ways, including by ensuring a sufficient supply of certified U.S. pilots who board foreign vessels to ensure safe navigation. Specifically, the Coast Guard is responsible for annually setting the rates U.S. pilots on the Great Lakes-Seaway charge carriers (referred to as pilotage rates for the remainder of this report).²⁰ In addition, the Coast Guard is also required by law to maintain heavy icebreaking capability on the Great Lakes to assist in keeping channels and ports open to navigation.²¹ Meanwhile U.S. Customs and Border Protection is responsible for screening cargo and passengers entering the United States at ports of entry, including Great Lakes ports.

¹⁸The inland waterway system, including the Mississippi River and its tributaries, involves a separate trust fund—the Inland Waterway Trust Fund—which is appropriated to finance construction and major rehabilitation projects on these waterways. See 26 U.S.C. § 9506.

¹⁹Water Resources Reform and Development Act of 2014, Pub. L. No. 113-121, § 2101 and 2102, 128 Stat. 1273 (codified at 33 U.S.C. §§ 2238b and 2238 (d)(1)(B)(ii)).

²⁰The Great Lakes Pilotage Act of 1960, as codified at 46 U.S.C. § 9303(f), requires the U.S. Coast Guard to annually review pilotage rates for the Great Lakes-Seaway. U.S.-flag and Canadian vessels that operate only in the Great Lakes are generally exempt from pilot requirements. Outside of the Great Lakes-Seaway system, pilotage rates in the United States are handled by the states.

²¹14 U.S.C. § 2(4) and (5).

Great Lakes-Seaway Cargo Levels Have Decreased since 1980 due to Various Economic Factors but Selected Stakeholders Report Recent Increased Diversity of Uses

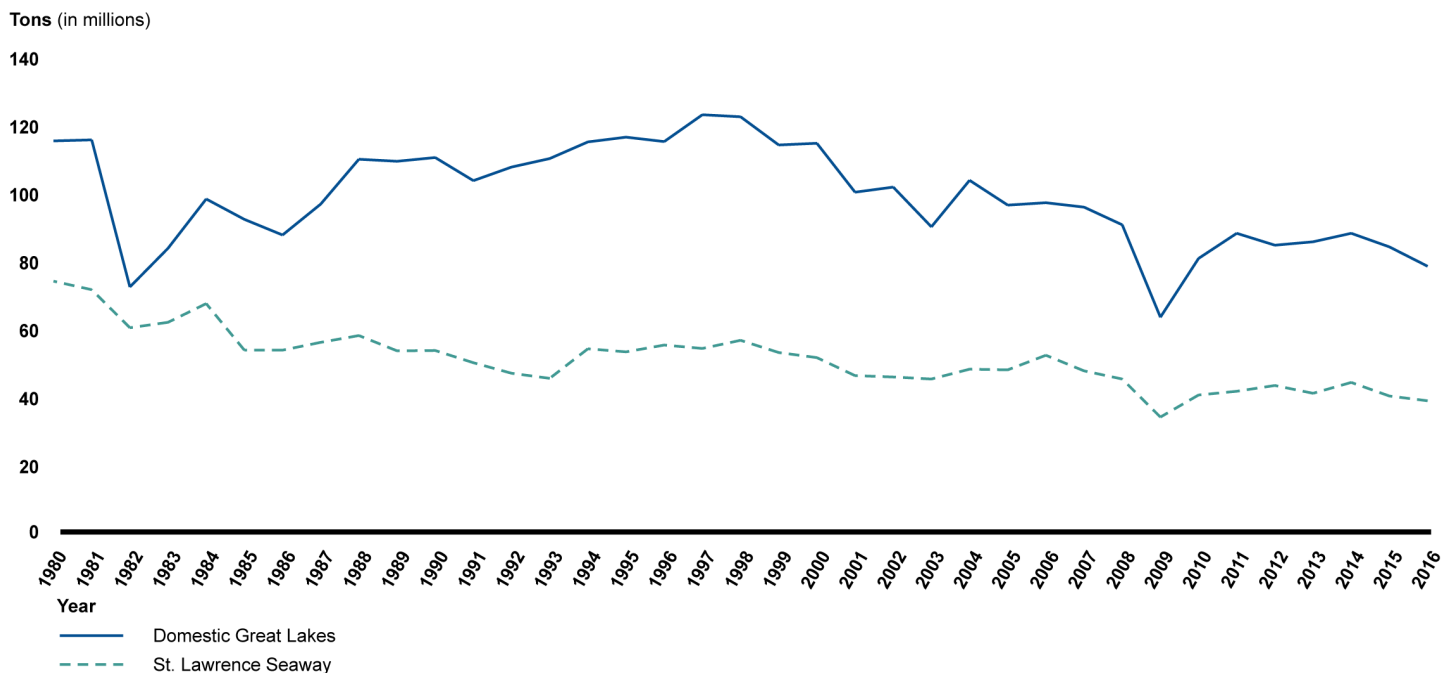
Stakeholders Identified a Variety of Economic Factors Associated with Decreased Cargo Levels on the Great Lakes-Seaway since 1980

The amount of cargo transported annually on the Great Lakes-Seaway—specifically for U.S. Great Lakes domestic and Seaway cargo—has generally declined since 1980 (see fig. 3). The Great Lakes U.S. domestic “laker” cargo traffic declined from about 115 million tons in 1980 to about 78 million tons in 2016—a decline of 32 percent—according to data from the Army Corps’ Waterborne Commerce Statistics Center.²² As noted in figure 3, the trend includes many noticeable year-to-year changes over this time period, which may be in response to broader economic factors, as discussed below. Meanwhile, cargo traffic on the St. Lawrence Seaway, which as described earlier is primarily transported by Canadian and foreign vessels, declined by 48 percent over the same time period, from about 74 million tons in 1980 to about 39 million tons in 2016, according to Seaway Traffic Data.²³

²²We report cargo amounts using short tons, which we refer to as “tons”, a unit of weight equal to 2,000 pounds.

²³Seaway traffic is reported in metric tons, which we converted to short ton equivalences by using a conversion factor.

Figure 3: Domestic Great Lakes and St. Lawrence Seaway Cargo Traffic (1980–2016), Millions of Tons



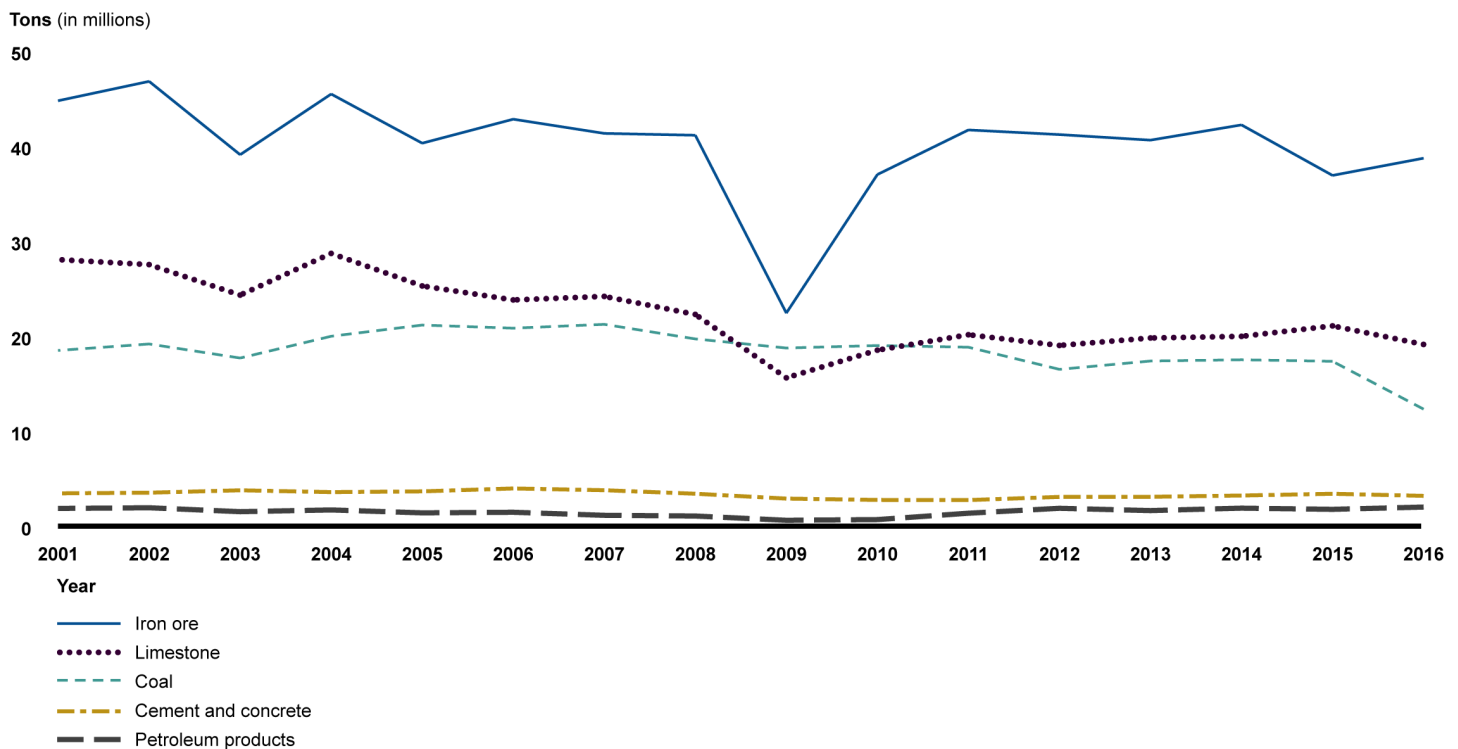
Source: GAO analysis of Army Corps Waterborne Commerce Statistics and St. Lawrence Seaway Traffic data. | GAO-18-610

Between 2001 and 2016, domestic Great Lakes cargo traffic levels were driven primarily by iron ore, limestone, and coal—three commodities that are closely tied to the steel industry (see fig. 4).²⁴ Specifically, these three commodities accounted for 90 percent of the total of about 78 million tons in domestic Great Lakes traffic in 2016—iron ore alone comprised 50 percent. Great Lakes domestic tonnage declined by about 22 million tons overall from 2001 to 2016, with declines in iron ore, limestone, and coal totaling about 21 million tons. Army Corps officials noted that other commodities such as wheat also have a presence on the Great Lakes,

²⁴As noted previously, we used 2001 to 2016 data from both agencies to examine trends over the past approximately 15 years.

with over 5 million tons of wheat traveling on the Great Lakes in 2017 according to these officials.²⁵

Figure 4: Domestic Great Lakes Cargo Traffic for Key Commodities, 2001–2016, Millions of Tons



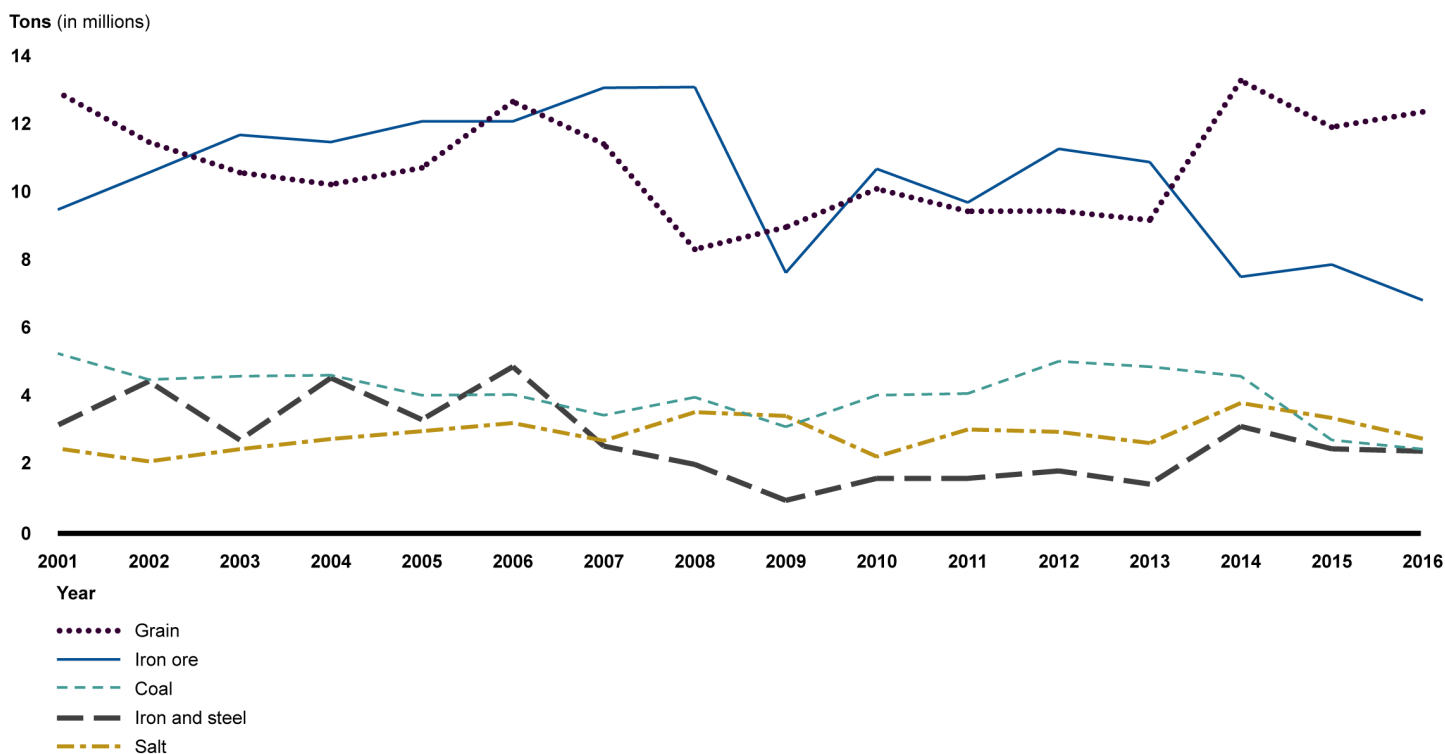
Source: GAO analysis of Army Corps Waterborne Commerce Statistics data. | GAO-18-610

In contrast to the domestic Great Lakes cargo traffic, the top five commodities on the St. Lawrence Seaway, which comprised 70 percent of total cargo traffic in 2016, show a more varied picture of the types of commodities and trends from 2001 to 2016 (see fig. 5). Grain, the top commodity transported on the St. Lawrence Seaway, comprised nearly a

²⁵We analyzed annual cargo traffic data for the St. Lawrence Seaway published jointly by the U.S. and Canadian Seaway Corporations and data on domestic Great Lakes cargo traffic using data published by the Army Corps. Although the Seaway data represents all cargo traffic that travels on the St. Lawrence Seaway, the Army Corps data we analyzed exclusively represents traffic between U.S. ports on the Great Lakes system. As a result, some cargoes that travel on the Great Lakes—such as between Canadian ports or U.S. and Canadian ports—are not included in this report. However, such movements would be captured in the Seaway data to the extent they enter the Seaway.

third of total Seaway traffic in 2016. Like the domestic Great Lakes traffic, iron ore and coal have a significant presence on the St. Lawrence Seaway, together comprising 24 percent of cargo traffic in 2016. In contrast to domestic Great Lakes traffic, iron and steel constitute key commodities on the St. Lawrence Seaway, declining from about 3.2 million tons in 2001 to about 2.4 million tons in 2016. Nearly all such iron and steel transports are imports destined for U.S. or Canadian ports. For example, some specialty steel used to package food in cans is manufactured in Europe and imported for use in the United States. Several stakeholders we interviewed told us that a balance between inbound iron and steel shipments and outbound grain exports are important in providing shipping capacity in both directions.

Figure 5: St. Lawrence Seaway Cargo Traffic for Key Commodities, 2001–2016, Millions of Tons



Source: GAO analysis of St. Lawrence Seaway Traffic data. | GAO-18-610

Stakeholders identified various economic factors that have affected Great Lakes-Seaway cargo traffic levels since the 1980s:

- *Global economic factors.* Many stakeholders noted that year-to-year trends in global prices for commodities such as grain, iron ore, and steel affect Great Lakes-Seaway cargo traffic levels. For example, two stakeholders told us that U.S. iron ore is exported through the St. Lawrence Seaway when global iron ore prices are high, allowing producers to cover the costs of shipping while also being price competitive internationally. Further, some stakeholders reported that the increase in globalization since 1980 has resulted in greater foreign competition to U.S. and Canadian commodities exported via the Great Lakes-Seaway. For example, one stakeholder noted that countries that were grain importers in the 1980s, such as Russia, have since become grain exporters, competing with U.S. and Canadian grain internationally. Grain traffic on the St. Lawrence Seaway fell by over 60 percent from about 32 million tons in 1980 to about 12 million tons in 2016, with nearly the entire decline occurring prior to 2001.
- *Domestic economic factors.* Several stakeholders told us that Great Lakes-Seaway cargo traffic rises and falls in conjunction with general economic conditions and trends, such as a sharp decline during the recession in 2009 (see fig. 3 above). For example, one stakeholder reported that a trend in the U.S. economy toward a more service-based rather than manufacturing-based economy has affected Great Lakes-Seaway traffic, reducing demand for manufacturing inputs such as iron ore. As we reported in 2013, manufacturing has accounted for a decreasing share of U.S. employment and economic output over the last several decades.²⁶
- *Industry-specific changes.* Changes in industries that have relied on the Great Lakes-Seaway for the transportation of input materials have affected cargo trends, according to several stakeholders. For example, demand for iron ore has been affected by the U.S. steel industry's move towards smaller manufacturing plants, which are located away from the Great Lakes and which use recycled metal and do not require iron ore.²⁷ Between 2001 and 2016, domestic Great

²⁶GAO, *Global Manufacturing: Foreign Government Programs Differ in Some Key Respects From Those in the United States*, [GAO-13-365](#) (Washington, D.C.: July 25, 2013).

²⁷Some stakeholders stated that a new manufacturing facility in Toledo, Ohio, will use iron ore transported on the Great Lakes to produce input material for the newer plants.

Lakes tonnage of iron ore declined by 14 percent, from about 45 million to about 39 million tons (see fig. 4 above). Several stakeholders also told us that changes in the power generation industry have reduced shipments of coal. For example, environmental concerns and competitive natural gas prices have led some utilities in Canada and the United States to close coal-fired facilities. St. Lawrence Seaway coal tonnage from 2001 to 2016 declined by 53 percent, from about 5.3 million to about 2.5 million tons (see fig. 5 above).

- *Greater competition among modes.* Several stakeholders said that certain other transportation modes have become more competitive with the Great Lakes-Seaway. For example, several told us that the use of shipping containers—which enable easy intermodal transfer between waterways, highway, and rail—has grown dramatically worldwide in the past several decades with implications for modal competition and the Great Lakes-Seaway. As we previously reported, the largest container vessels in 2016 could carry nearly 18,000 standard 20-foot shipping containers, roughly twice as many as in 2005.²⁸ However, most modern containerships are too large to use the Great Lakes-Seaway locks and container service on the system is limited. Three stakeholders that sometimes use the Great Lakes-Seaway to import cargo reported that they can also import cargo to the Midwest via coastal ports, where containers can be transferred from container ship to truck or rail for inland delivery. While traffic on the Great Lakes-Seaway has generally declined since 1980, according to data published by the U.S. Bureau of Transportation Statistics, U.S. railroad freight nearly doubled from 1980 to 2015, from 932,000 to 1.7 million ton-miles.²⁹

Stakeholders Report Recent Increased Diversity in Uses of the Great Lakes-Seaway

Stakeholders reported a recent increase in the diversity in the use of the Great Lakes-Seaway, although bulk commodities continue to constitute the majority of the 78 million and 39 million tons of domestic Great Lakes and St. Lawrence Seaway cargo traffic in 2016, respectively. The reported increase in the diversity of uses includes:

- *Project cargo.* Some stakeholders told us shipments of project cargo—specialty items that may be difficult to move by rail or truck

²⁸GAO, *West Coast Ports: Better Supply Chain Information Could Improve DOT's Freight Efforts*, [GAO-17-23](#) (Washington, D.C.: Oct. 31, 2016).

²⁹A ton mile is a unit of transportation and is defined as one ton of freight carried one mile.

due to width or weight limits, such as windmill blades, beer fermentation tanks, and mining equipment—have increased in recent years. The tonnage of St. Lawrence Seaway traffic comprised of machinery and other manufactured products, which encompass project cargo, grew from about 657,000 tons in 2001 to about 1.1 million tons in 2016. Project cargos are typically chartered on an as-needed basis. One stakeholder said that carriers would need to offer more ships capable of carrying project cargo as a prerequisite for any large future increases in project cargo.

- *Containers.* Although containers continue to represent a small fraction of total cargos on the St. Lawrence Seaway, container traffic on the Seaway more than tripled from 18,156 tons in 2001 to 64,984 tons in 2016.³⁰ The only regular container service on the system began in 2014 and operates between ports in Cleveland and Antwerp, Belgium. The service is offered through a partnership between the Port of Cleveland, where officials told us they view the service as a way to attract traffic, and a Dutch carrier, whose representatives view it as a way to educate U.S. manufacturers on the advantages of maritime transportation. Representatives from the carrier said that the service offers 44 sailings annually.
- *Cruises.* Several stakeholders said that there is recent growth of small passenger cruises on the Great Lakes-Seaway with the potential for further growth. Some of those stakeholders said that the region affords advantages including a variety of scenic destinations. A typical cruise may begin and end in Chicago and Toronto, both of which have air connections for arriving and departing passengers. An official from the U.S. Seaway Corporation said that the number of cruise ships operating on the system grew from 5 to 8 and the number of voyages offered grew from 54 to 92 between 2014 and 2018. The official said that additional ships and voyages are expected in the future.

³⁰ Container traffic is typically measured according to the number of standard 20-foot shipping containers, but traffic data available for the St. Lawrence Seaway data records container traffic in tons. Container traffic on the St. Lawrence Seaway accounted for 0.2 percent of cargo tonnage in 2016.

Selected Stakeholders Identified Various Challenges to Using the Great Lakes-Seaway, but the U.S. Seaway Corporation Has Not Fully Assessed Risks

Traditional and Emerging Great-Lakes Seaway Uses Face a Range of Challenges, according to Stakeholders

Stakeholders we met with identified a range of challenges to using the Great Lakes-Seaway and noted that these challenges pose risks to the future use of the system. Although many of the challenges that stakeholders identified—such as the annual winter closure—affect all users of the system, some challenges may impact the system’s various users differently. Specifically, some challenges directly affect the “traditional use” of the system—including the transport of bulk cargos such as iron ore, grain, and steel—while other challenges primarily affect “emerging use” of the system, such as the cruise industry and container market, as discussed below. The cumulative effect of all the challenges represents costs and system reliability risks to shippers that can erode the advantages that the system has traditionally offered over other transportation modes. For example, a representative from one shipping company told us the company frequently compares the cost of using the Great Lakes-Seaway to other modes and noted that the margin favoring the Great Lakes-Seaway is becoming narrower due to the system’s various challenges.

Challenges to Traditional System Use

Stakeholders identified several challenges that affect traditional uses of the Great Lakes-Seaway, including transport of dry bulk commodities and imported steel.

- *Recent Increase of Pilotage Rates:* The majority of stakeholders we interviewed reported that recent rate increases in the costs of securing pilots, who are intended to ensure safe navigation, have significantly increased costs for foreign ocean going vessels operating in the Great Lakes-Seaway. Federal law requires that certified pilots

board foreign vessels while in the Great Lakes-Seaway.³¹ A pilot may be on board for multiple days on a single voyage, given the size of the system. As part of its responsibility to set rates that pilots charge carriers for the Great Lakes-Seaway,³² the U.S. Coast Guard revised the methodology used to calculate the rates in 2016.³³ Coast Guard officials told us the methodology had not changed since the mid-1990s and changes were needed to bring rates up to a sufficient level to attract and retain pilots. Specifically, according to the Coast Guard the number of pilots in the region decreased from 44 in 2007 to 36 in 2014, resulting in pilot shortages and traffic delays.³⁴ In response, the Coast Guard raised rates. For example, in the St. Lawrence River portion of the system, pilotage rates increased 23 percent between 2014 and 2016. According to one carrier association we interviewed, pilotage is one of the single largest cost items for foreign vessels entering the system.³⁵ Similarly, representatives from a carrier association told us pilotage rates are a primary challenge affecting the cost competitiveness of the system compared to truck and rail. The methodology used to calculate rates was revised further in 2017³⁶ and 2018³⁷ and Coast Guard officials report that the recent updates have accounted for factors, such as eliminating a weighting factor based on the size of the vessel. According to Coast Guard officials, these changes corrected factors that were not properly accounted for in previous years and effectively lowered rates compared with 2016. The Coast Guard also authorized an increase in the number of registered pilots, from 36 in 2014 to 45 in 2017.

- *Condition of the Poe-lock Infrastructure:* Several stakeholders that operate on the Great Lakes told us that they are concerned about the condition of the Poe lock (see fig. 6). One Great Lakes shipper

³¹46 U.S.C. § 9302.

³²The U.S. Coast Guard's regulations for establishing pilotage rates are codified in 46 C.F.R. Part 401.

³³81 Fed. Reg. 11908 (March 7, 2016).

³⁴81 Fed. Reg. 11908 (March 7, 2016).

³⁵According to Canadian Seaway Corporation officials, Canada also requires pilots on foreign-flag vessels, though the rates are set by a different process and did not increase as much as rates in the U.S. in 2016.

³⁶82 Fed. Reg. 41466 (August 31, 2017).

³⁷83 Fed. Reg. 26162 (June 5, 2018).

representative told us that they believe the Poe lock is at critical risk of lock failure that could result in an unplanned outage and disrupt the U.S. steel industry, which has limited alternatives (rail or truck) to move large amounts of iron ore from Minnesota and Michigan's Upper Peninsula to steel manufacturing plants in the lower Great Lakes. As mentioned previously, many U.S. laker vessels can only fit in the larger Poe lock at the Soo locks due to vessel size. For example, the Army Corps estimated that 85 percent of the tons of cargo travelling through the Soo locks in 2017 were restricted to using the Poe lock. A representative from a Great Lakes carrier told us that a closure of the Poe lock for repairs during the shipping season could pose further challenges to using the system, since there is currently no redundant Poe-sized lock to which traffic could be diverted.³⁸ As discussed below, Army Corps officials note they currently lack the means to replace the Poe lock's upper miter gate—which was identified as critical in 2007—without disrupting navigation. The Army Corps' asset renewal efforts to improve lock condition, including the Poe lock, are discussed in greater detail below.

³⁸As mentioned previously in this report, the Army Corps recently completed an analysis of the benefits and costs of constructing a second Poe-sized lock. According to the Army Corps, the project is estimated to cost approximately \$922 million and will compete for funding with other construction projects throughout the country through the agency's budgeting process. The decision to fund the new lock also involves review by the Office of Management and Budget for inclusion in the President's budget and Congressional appropriation of funds.

Figure 6: The Poe Lock, Located at Sault Ste. Marie, Michigan, and Managed by the U.S. Army Corps of Engineers



Source: U.S. Army Corps of Engineers. | GAO-18-610

- *Regulatory Complexity Related to Ballast Water:* Several agencies are involved in regulating ballast water in the Great Lakes-Seaway, and several stakeholders reported that the complexity of the regulatory environment poses a challenge to using the system.³⁹ Ballast water is taken up or discharged in a vessel's tanks to improve stability during voyages and when cargo is loaded or unloaded. Ballast water regulations are aimed at preventing the introduction of invasive species collected in foreign waters from transoceanic vessels and

³⁹Federal requirements for ballast water in the United States are found in the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Pub. L. No. 101-646, 104 Stat. 4761 (1990), codified at 16 U.S.C. §§ 4701-4751) and the Clean Water Act (codified at 33 U.S.C. §§ 1251 et seq.)—and related Coast Guard and U.S. Environmental Protection Agency regulations.

discharging them into the Great Lakes.⁴⁰ These regulations involve joint U.S.-Canadian Seaway regulations as well as requirements from the U.S. Coast Guard, U.S. Environmental Protection Agency (EPA), and some states. Specifically, under the current framework, all oceanic vessels bound for the Great Lakes-Seaway are tested to meet the ballast water discharge standards established by the U.S. Coast Guard and the EPA.⁴¹ Most lakers, which are confined to the Great Lakes and unlikely to introduce new aquatic invasive species from outside the Lakes, are not subject to the Coast Guard and EPA requirements.⁴² In addition, states are authorized to establish their own vessel discharge control measures, and according to an industry association, several Great Lakes states have their own ballast water requirements.⁴³ One carrier association representative told us that the various ballast water regulations can cause confusion over how the regulations apply across the system.

U.S. Seaway Corporation officials said they are aware of these issues and since 2007, the U.S. and Canadian Seaway Corporations have been operating under harmonized, joint ballast water regulations intended to eliminate confusion among users of the system.⁴⁴ In addition, both Corporations participate in the Great Lakes Seaway

⁴⁰We have reported that ballast water is one of pathways by which nonnative and invasive species have arrived in the Great Lakes. Specifically, GAO reported that the introduction in the late 1980s of nonnative zebra mussels into the Great Lakes via ballast water cost millions of dollars in economic and ecological losses due to zebra mussels clogging municipal and industrial water pipes and out-competing native mussels for food and habitat. GAO, *Invasive Species: Clearer Focus and Greater Commitment Needed to Effectively Manage the Problem*, [GAO-03-1](#) (Washington, D.C.: Oct. 22, 2002) and GAO, *Invasive Species: Progress and Challenges in Preventing Introduction into U.S. Waters Via the Ballast Water in Ships*, [GAO-05-1026T](#) (Washington, D.C.: Sept. 9, 2005). See also GAO, *Aquatic Invasive Species: Additional Steps Could Help Measure Federal Progress in Achieving Strategic Goals*, [GAO-16-49](#) (Washington, D.C.: Nov. 30, 2015).

⁴¹Department of Homeland Security, Coast Guard, *Standards for Living Organisms in Ships' Ballast Water Discharged in U.S. Waters*, 77 Fed. Reg. 17254 (March 23, 2012); U.S. Environmental Protection Agency, *National Pollutant Discharge Elimination System (NPDES) Vessel General Permit for Discharges Incidental to the Normal Operation of a Vessel*, 78 Fed. Reg. 21938 (Apr. 12, 2013).

⁴²All Lakers are currently exempt from complying with the regulations in the U.S. Coast Guard's 2012 Final Rule, and the Lakers built before January 2009 are exempt from the EPA's 2013 Final Rule.

⁴³16 U.S.C. § 4725; 33 U.S.C. §1370.

⁴⁴Department of Transportation, Saint Lawrence Seaway Development Corporation, Final Rule, 73 Fed. Reg. 9950 (Feb. 25, 2008), codified at 33 C.F.R. Part 401.

Challenges to Emerging System Use

Ballast Water Working Group, which is comprised of representatives from the U.S. Coast Guard and others. The group's mission is to coordinate regulatory, compliance, and research efforts to reduce the introduction of aquatic invasive species via ballast water. The working group reported in 2018 that such coordination will help minimize the creation of a patchwork of inconsistent regulations.⁴⁵

- *Effect of insufficient dredging:* Several stakeholders we met with said that insufficient dredging—removal of sediment and debris from the bottom of ports to maintain water levels for maximum vessel load—can pose a challenge to using the Great Lakes-Seaway. In particular, a stakeholder noted the Army Corps, which is responsible for dredging the major U.S. ports on the Great Lakes, has limited capacity to keep up with all ports' dredging needs, and that this situation can lead to vessels having to engage in "light loading"—filling to a lower capacity to reduce vessel weight—to access affected ports.⁴⁶ The Army Corps reported in 2018 that its dredging backlog has decreased to 13.5 million cubic yards from a high of 18 million in 2013. One stakeholder that uses the Great-Lakes Seaway to ship iron ore told us that light loading causes steel mills to operate at lower capacity when they do not receive the required amount of iron ore. Army Corps officials told us that high water levels in recent years have allowed vessels to carry more tons of cargo. However, because water levels fluctuate over time, those conditions could change and affect load efficiency.

Stakeholders also identified challenges that particularly affect emerging uses of the Great Lakes-Seaway, such as the cruise industry and container market.

- *Winter closure:* The majority of stakeholders we interviewed told us the annual winter closure hurts the system's competitiveness because shippers must either stockpile their cargo or find alternative modes of transport during the winter months. While winter closure has been a long-standing feature of the system, it poses a particular challenge for the emerging container market since, as a stakeholder from a carrier association noted, containerized cargo is often time-sensitive and

⁴⁵2017 Summary of Great Lakes Seaway Ballast Water Working Group (January 2018).

⁴⁶The amount of cargo that must be forfeited varies depending on the size of the vessel. For example, for U.S.-flag laker vessels between 1,000 feet to 500 feet, just one inch of reduced draft trims anywhere from 50 to 270 tons of cargo from their payload. See Great Lakes Maritime Task Force. *Great Lakes Dredging Crisis* (March 2013).

cannot be stockpiled. Securing an alternative transportation mode during the winter closure may be challenging because railroads, for example, prefer to sign year-round contracts for shipping rather than shorter-term winter arrangements. Additionally, some stakeholders told us lack of icebreaking during the start and end of the season, particularly during severe winters, has caused vessel delays.⁴⁷ The U.S. Coast Guard's icebreaking fleet consists of nine vessels on the Great Lakes. In 2016, a U.S. Coast Guard report identified some ice breaking issues that led to 3- and 6-week delays in 2010.⁴⁸ The report detailed actions the U.S. Coast Guard took to mitigate future delays, including moving an icebreaking vessel's home port to a Great Lakes port, but also noted that procuring an additional heavy icebreaker is not cost-effective. An example of potential delays caused by ice was demonstrated in January 2018 when a vessel became frozen in the U.S. Seaway Corporation's Snell lock during extreme weather conditions, delaying five vessels and necessitating the system's closure for 11 days. Efforts to free the vessel included ice melting equipment and tug boats.

- *Limited U.S. Customs and Border Protection resources for clearing passengers and container cargo:* Several stakeholders we interviewed told us that the limited capacity of U.S. Customs and Border Protection's processing of container cargo and passengers poses a challenge for emerging system uses. U.S. Customs and Border Protection is responsible for inspecting travelers and imported cargo that enters the U.S., including at the ports of entry in the Great Lakes regions. U.S. Customs and Border Protection officials told us that their procedures for processing containers and passengers are more involved than traditional bulk cargos and that processes differ by port. For example at the Port of Detroit, cruise passengers are transported by bus to facilities a few miles away for processing. According to a representative from a cruise industry association, this processing creates delays and poses a challenge to the developing cruise industry. Officials from U.S. Customs Border and Protection offices in the Great Lakes region told us that their resources for processing passengers and cargos are located at main ports of entry (such as airports) and that at the Great Lakes ports are lacking appropriate facilities, tools, technology, equipment, and personnel. These same

⁴⁷Icebreaking in the Great Lakes-Seaway is coordinated and operated jointly by the U.S. and Canadian Coast Guards.

⁴⁸U.S. Coast Guard, Department of Homeland Security, *Great Lakes Icebreaking Mission Analysis, Fiscal Year 2016 Report to Congress* (Aug. 30, 2016).

officials said that if the Great Lakes ports were to handle increasing numbers of passengers and containers, U.S. Customs and Border Protection would need sufficient time and budget to add inspection equipment, but that port operators would need to bear the costs of upgrading their facilities.

- *Inadequate portside infrastructure:* Some stakeholders told us that many of the ports along the Great Lakes-Seaway were developed to support bulk commodities—such as iron ore, coal, and grain—and are not equipped to easily handle containers. Bulk commodities do not require portside equipment at destination ports since they are transported by self-unloading vessels and are often delivered straight to private docks, such as iron ore delivered to a steel manufacturing facility. As such, Great Lakes ports generally lack multimodal connections that enable transfer of containers from vessel to truck and rail routes. A representative from a company that ships containers on the Great Lakes-Seaway told us that the port nearest its location does not have cranes to handle containers. Instead, the company uses a different port that is further away because it has the infrastructure necessary to ship containers. Port representatives told us that financing options exist to make upgrades to port infrastructure but consistent and sustainable traffic levels are needed in order to justify investments. For example, an official from the Port of Cleveland told us they have access to their own financing and have added infrastructure to create their container business, including cranes, storage warehouses, and right-of-way for rail connections using revenue bonds issued by the board that oversees the port. An official from the Port of Indiana told us that the port lacks infrastructure to handle containers, but it would find the financing to make investments in container equipment if there were a consistent stream of business.

The U.S. Seaway Corporation Has Not Fully Assessed the Risks That Challenges Pose to System Utilization

Although U.S. Seaway Corporation officials told us they are aware of system challenges cited by stakeholders, the Corporation has not fully assessed the extent to which the challenges pose risks to the use of the Great Lakes-Seaway. As previously noted, the U.S. Seaway Corporation's stated mission is to improve the operation and maintenance of a safe, reliable, and efficient waterway and to improve regional economic and trade development by enhancing utilization of the entire Great Lakes Seaway system.⁴⁹ To achieve this mission, the U.S. Seaway

⁴⁹According to Army Corps Detroit District officials, the Army Corps does not have an overarching strategy to encourage utilization of the Great Lakes-Seaway, other than to keep the system as reliable as possible within funding provided.

Corporation's strategic plan includes several goals, such as increasing the volume and value of commercial trade through the Great Lakes Seaway System, while promoting cost-effective competition for all users. To achieve these goals, the plan lists several actions, including developing initiatives to improve capacity of the system, and working with carriers, ports, pilots, and other stakeholders to contain costs and foster increased trade in the region.⁵⁰ For example, the U.S. Seaway Corporation has taken steps to improve the condition of lock infrastructure—as discussed in greater detail below—and in 2015, hired a full-time employee, stationed in Cleveland, Ohio, who is responsible for advancing the Corporation's trade and economic development activities in the Great Lakes region. However, the Corporation has not taken steps to identify, analyze and monitor challenges that affect use of the system, such as those identified by the stakeholders we interviewed.

The Standards for Internal Control in the Federal Government states that assessing risks and monitoring changes are key to achieving objectives. Specifically, management should analyze identified risks to estimate their significance, which provides a basis for responding to the risks, and design responses to the analyzed risks so that risks are within the defined risk tolerance for the defined objective.⁵¹ The standards also note that monitoring is key to ensuring that the process used by management to help achieve its objectives remains aligned with changing environments, laws, and resources.⁵² The importance of understanding risks to system use in the Great Lakes Seaway was also emphasized by the Conference of Great Lakes and St. Lawrence Governors and Premiers. This conference, made up of Governors and Premiers of the eight states and two Canadian provinces along the Great Lakes-Seaway, developed a 2016 strategy that delineated system challenges and called for an analysis of the total costs of moving cargo through the system and how this compares to other modes.⁵³ U.S. Seaway Corporation officials told us they are supportive of the Conference's strategy but are not working to implement this analysis or other elements of the strategy.

⁵⁰The plan also establishes performance measures to track vessel delays due to lock equipment failure, as discussed below.

⁵¹[GAO-14-704G](#).

⁵²[GAO-14-704G](#).

⁵³Conference of Great Lakes and St. Lawrence Governors and Premiers, *Strategy for the Great Lakes-St. Lawrence River Maritime Transportation System* (June 15, 2016).

Although some actions have been taken to address challenges, officials from the U.S. Seaway Corporation told us that the Corporation has not fully assessed risks to Great Lakes-Seaway use, in part because the Corporation does not have a formal or standing process to monitor risks over time. The U.S. Seaway Corporation has worked closely with other federal agencies over the years, including the Army Corps and Coast Guard, to address challenges. For example, in 2007, it played a role in the joint U.S.-Canadian study that focused attention on the system's infrastructure,⁵⁴ and the Corporation has worked with the Coast Guard and others in the Great Lakes Seaway Ballast Water Working Group. In addition, although U.S. Seaway Corporation officials told us that they have a limited role in addressing challenges involving other agencies, the U.S. Seaway Corporation has some experience assessing system risks that could be useful in better understanding and addressing challenges facing system users. For example, in 2012, the U.S. Seaway Corporation was involved in a study led by the Canadian Seaway Corporation that examined the cost-competitiveness of the Great Lakes-Seaway and included a discussion of risks. These efforts could be useful in developing a process to track risks and monitor how they evolve over time and in relation to current shipping trends so that further actions could be taken to address challenges faced by traditional and emerging users of the system.

Establishing a process to assess and monitor system risks would provide the U.S. Seaway Corporation with greater assurance that the actions taken by the Corporation, including those listed in its strategic plan, and by other stakeholders are working to improve future utilization and ensure efficient use of the system. Without a formal assessment of risks, the U.S. Seaway Corporation lacks information on the cumulative effect of the challenges faced by users of the system, limiting its ability to inform its future actions to help address those challenges.

⁵⁴ *Great Lakes St. Lawrence Seaway Study* (Fall 2007).

The U.S. Seaway Corporation and the Army Corps Have Made Progress on Lock Asset Renewal Efforts, but the Army Corps Lacks Associated Goals and Measures

Both Agencies Have Made Progress on Lock Asset Renewal Efforts, but the Army Corps Has Yet to Start Work on a Project Identified as Critical in 2007

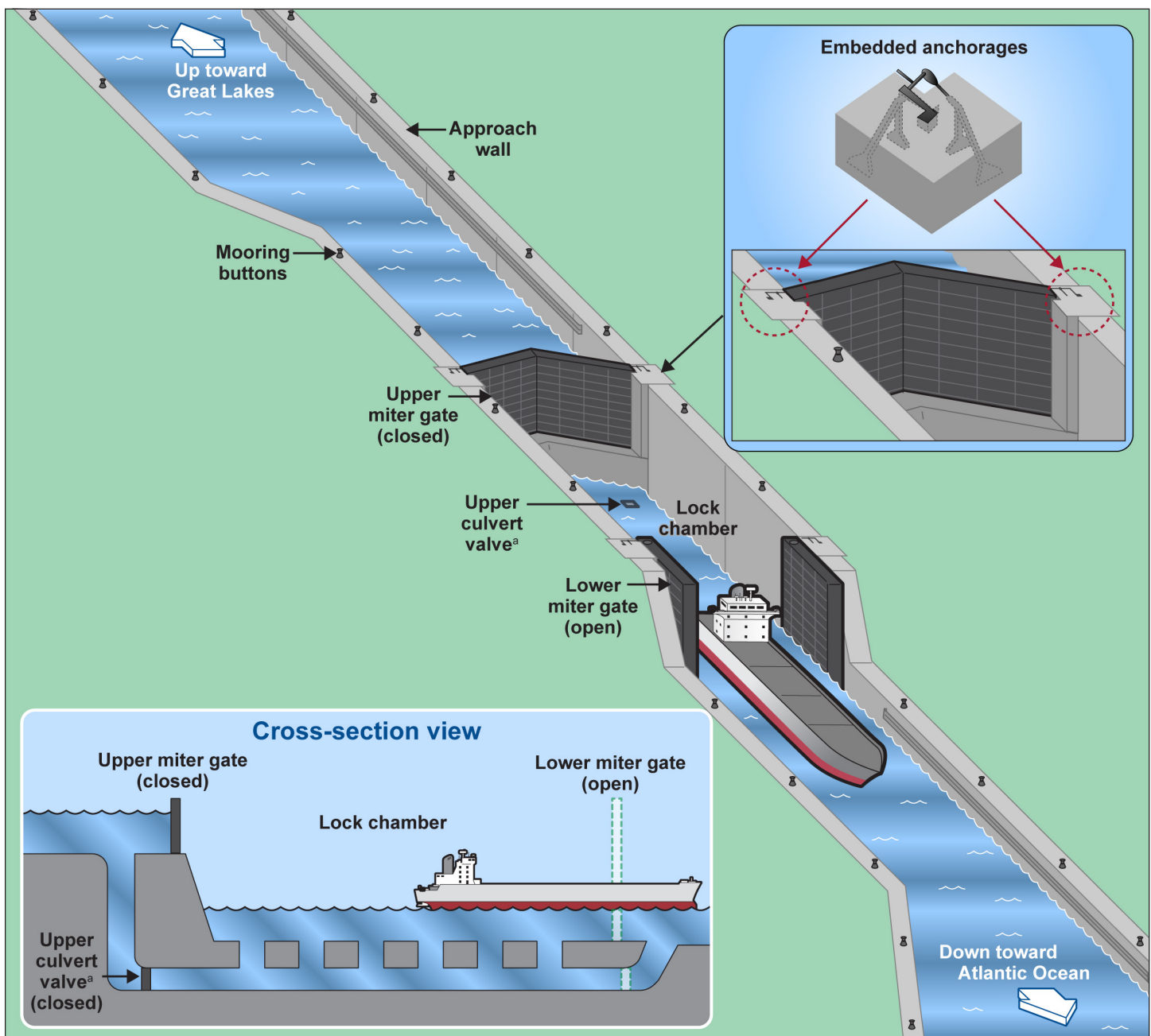
The Army Corps and the U.S. Seaway Corporation developed asset renewal plans, in fiscal year 2007 and 2009 respectively, which were originally intended to cover approximately 10 years and focused on modernizing, rehabilitating, or replacing existing lock components to avoid unexpected lock closures.⁵⁵ Within a lock there are a number of structural, mechanical, and electrical components that must work together (see fig. 7). Key lock components included in the agencies' asset renewal plans include:

- *Approach walls*—Help guide the vessel as it approaches the lock chamber and provides a place for the vessel to tie up to wait to enter the lock chamber.
- *Lock chamber*—Concrete structure with rock or concrete floors that contain the vessel while water flows to empty or fill the chamber. The lock structure houses the culvert valves, which fill and empty the lock.
- *Miter gates*—Steel structures that first function as a dam to prevent free flow of water through a lock, then open and close to allow vessels to transit through the lock. The end of the gates are mitered (angled) and use the difference in water levels to provide the force necessary to achieve a nearly water-tight seal.

⁵⁵Although we do not evaluate these efforts, the Canadian Seaway Corporation also undertook asset renewal efforts around this same time.

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- *Embedded anchorages*—The connection point between the miter gates and lock walls, which transfers the load from the gate to the lock wall during the opening and closing of the gates.

Figure 7: Illustration of a Lock and Its Selected Components



Source: GAO. | GAO-18-610

^aThe location of the culvert valves can vary by lock. For example the culvert valves for the U.S. Seaway Corporation locks are located in the lock wall.

Over the past decade since beginning these efforts, the Army Corps and U.S. Seaway Corporation have made progress on asset renewal efforts.⁵⁶ The Army Corps' asset renewal efforts have a total estimated cost of about \$310 million for work through 2035.⁵⁷ Meanwhile the U.S. Seaway Corporation's asset renewal efforts have a total estimated cost of \$189 million for work through 2023 (see fig. 8).⁵⁸ (See appendix II for a complete list of both agencies' asset renewal projects.) According to the Army Corps' most recent asset renewal plan from 2016 and updates provided by Army Corps officials in May 2018, to date, the Army Corps has spent about \$53 million on 18 completed projects out of the about \$86 million it has received since 2008 (see below for more information on funding received per year for both agencies).⁵⁹ The U.S. Seaway Corporation estimates it has spent \$45 million on 16 completed projects of the about \$137 million it has received since 2009. According to the Army Corps' estimates, it has about \$257 million in remaining and ongoing work through 2035. Meanwhile, the U.S. Seaway Corporation estimates it has almost \$144 million in remaining and ongoing work through 2023. Officials from both agencies stated that asset renewal plans will transition to ongoing capital investment programs that will continue into the foreseeable future. Army Corps Detroit District Officials also emphasized that the list of asset renewal projects frequently changes to account for new information such as results of facility inspections. These officials also noted that a project's inclusion in the asset renewal plan does not obligate future funds on behalf of the Army Corps, since all projects must compete for funding as part of the annual budget process. Furthermore, these Army Corps officials noted that the total cost estimate could decrease if a second Poe-sized lock is constructed, since traffic

⁵⁶The asset renewal plans also included some capital projects not directly tied to improving lock infrastructure condition, such as facility improvements.

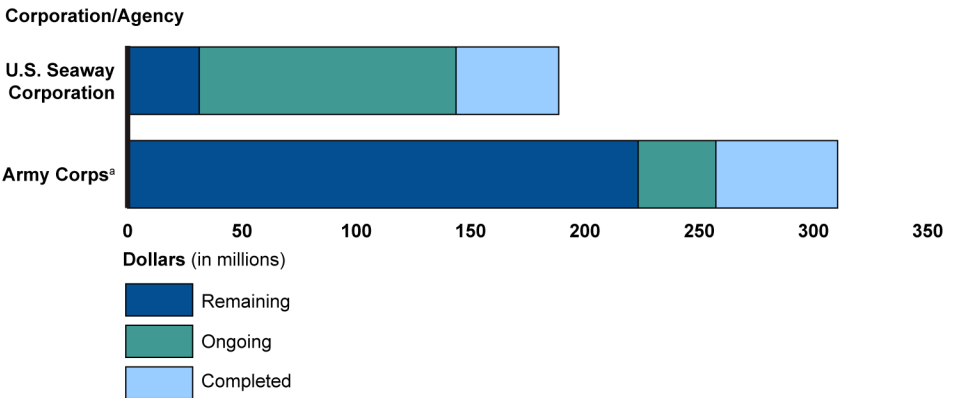
⁵⁷The Army Corps' estimates are based on the most recent asset renewal plan report from 2016, with updates provided by Detroit District officials in May 2018. The 2016 asset renewal plan notes that it outlines necessary work through 2035. It was beyond the scope of this review to check these cost estimates for accuracy and completeness.

⁵⁸The U.S. Seaway Corporation estimates are based on project-by-project expenditures for fiscal years 2009 through 2016 and cost estimates for work from fiscal years 2017 through 2023 provided in March 2018. It was beyond the scope of this review to check these cost estimates for accuracy and completeness.

⁵⁹For the U.S. Seaway Corporation, this denotes expenditures rather than obligations. According to U.S. Seaway Corporation information, from fiscal years 2009 through 2016, the Corporation obligated approximately \$68 million to ongoing projects, about \$17 million more than the approximately \$51 million expended for ongoing projects.

could be diverted to the new lock, allowing the current lock to be taken out of service for repairs.⁶⁰

Figure 8: Total Asset Renewal Cost Estimate by Project Status as of 2018 for U.S. Army Corps of Engineers (Army Corps) through 2035 and U.S. Saint Lawrence Seaway Corporation (U.S. Seaway Corporation) through 2023



Source: GAO analysis of Army Corps and U.S. Seaway Corporation information. | GAO-18-610

^aThe Army Corps' cost estimate for remaining projects includes \$82.6 million to complete the West Center Pier approach wall, which Army Corps officials estimate they can complete for less (\$7.5 million) in the event a new Poe-sized lock were constructed.

Both agencies have also made progress addressing critical projects identified in the 2007 study, but the Army Corps faces obstacles in finishing key projects without disrupting traffic through the Poe Lock. In the 2007 study, the U.S. Seaway Corporation and the Army Corps identified several critical projects to improve the condition of their respective locks (see table 1). The U.S. Seaway Corporation has completed its rehabilitation of the downstream miter gates on both locks and started work on a long-term project to rehabilitate concrete on the Eisenhower lock. Of the three key Army Corps projects identified in the 2007 study, one is complete, one is ongoing, and the other is remaining. Specifically, the Army Corps has not started work to replace the Poe lock's upper miter gate because Army Corps officials say they lack the means to replace the gate without disrupting navigation. In the short term, Army Corps officials say they now plan to repair the gate and have

⁶⁰As mentioned previously, the Army Corps' recently reported that constructing a new Poe-sized lock would cost approximately \$922 million. According to the Army Corps, if built, the new lock would not be operational for 7 to 10 years from the beginning of construction.

requested \$2 million in appropriated funds in fiscal year 2019 for the first phase of this work. Army Corps officials also noted they have ongoing work to reinforce the West Center Pier, which has eroded over time and which forms the approach channel for both the Poe and MacArthur locks. However, these officials reported that the cost to complete the work differs greatly (\$82.6 million versus \$7.5 million) depending on whether a second Poe-sized lock is constructed, since more expensive construction methods are currently needed to avoid disrupting traffic.

Table 1: Saint Lawrence Seaway Development Corporation’s (U.S. Seaway Corporation) and U.S. Army Corps of Engineers’ (Army Corps) Progress on Key Asset Renewal Projects Identified in 2007, as of 2018

	Key project identified in 2007	Project’s current status	Agency project cost estimate or total
U.S. Seaway Corporation ^a	Downstream lock miter gates for both the Snell and Eisenhower locks	Complete	Rehabilitated the gates on both locks for almost \$7 million
	Lock concrete at the Eisenhower lock	Ongoing	To date spent just over \$200,000 to rehabilitate concrete but estimates an additional \$8 million needed in the future. According to U.S. Seaway Corporation officials, this project requires ongoing investment due to the materials used when the lock was originally constructed.
Army Corps ^b	MacArthur lock’s electrical controls	Complete	Modernized 70-year old electrical infrastructure for about \$8.5 million
	West Center Pier, which forms the approach channel for both the Poe and MacArthur locks	Ongoing	To date spent \$9 million to reinforce approach walls but cost of remaining work depends on the decision to build a Poe-size lock. According to the Army Corps, without the new lock, the cost estimate is \$82.6 million. If a new lock is built, the estimated cost is \$7.5 million
	Poe lock upper miter gate	Remaining	Short term aim to repair the gate at estimated \$6.3 million. Longer-term projects include fabricating a spare gate (\$11.1 million) and procuring a crane (\$6.5 million) to replace the gate.

Source: GAO analysis of Army Corps and U.S. Seaway Corporation information. | GAO-18-610

^aThis information does not include two of the U.S. Seaway Corporation’s projects listed as key in the 2007 report which were not directly tied to lock functioning (rehabilitating a roadway bridge and highway tunnel).

^bThe 2007 study also mentioned a power canal project as critical, but according to officials, the Army Corps later determined that the infrastructure was sufficient as-is and did not require work.

In addition to addressing key projects from the 2007 report, over the past decade the Army Corps and U.S. Seaway Corporation have undertaken projects to address emergent issues and make operational improvements to lock infrastructure. For example, in late July 2015, the Army Corps identified the MacArthur lock’s embedded gate anchorages as a critical issue requiring immediate attention. It closed the MacArthur lock for 19

days during the navigation season in August 2015 in order to address the issue at a project cost of \$5.8 million. Meanwhile, the U.S. Seaway Corporation is working to install “hands-free mooring” at both of its locks, which is intended to improve the efficiency of lock operations. Hands-free mooring was developed by the Canadian Seaway Corporation, is being deployed on all Seaway locks, and eliminates the need for conventional lines to secure a vessel during the lockage process—instead, arms along the side of the locks extend and secure the vessel using vacuum pads. Once fully implemented, the system is expected to produce benefits such as improved workplace safety and reducing the time to transit a Seaway lock by approximately 7–10 minutes each direction. The U.S. Seaway Corporation expects to have the system completed by the end of the 2019 shipping season, at a total cost of about \$18 million, about \$7 million of which had been spent through 2016.

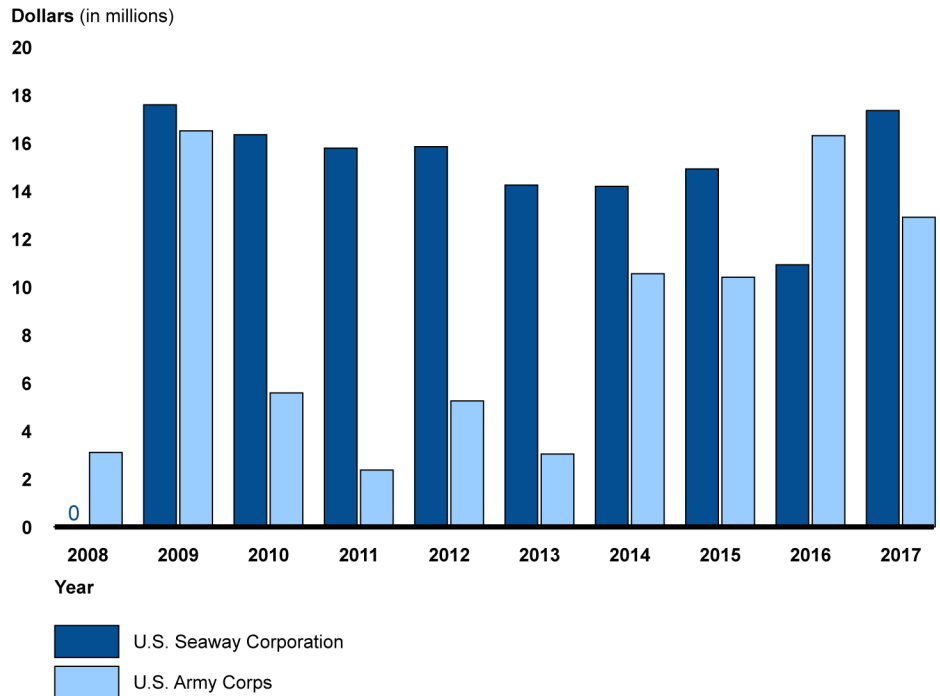
The Army Corps and the U.S. Seaway Corporation differ in the level of funding they have received for asset renewal efforts in the past decade, which may have influenced the agencies’ pace of asset renewal efforts. Through fiscal year 2017, the Army Corps received about \$86 million (starting in fiscal year 2008) and the U.S. Seaway Corporation received about \$137 million (starting in fiscal year 2009) (see fig. 9). Army Corps officials noted they received an increase in funds in 2009 due to the American Recovery and Reinvestment Act of 2009⁶¹ as well as more stable recent funding due to the Water Resources and Development Act of 2014⁶² which, as mentioned earlier, required the Army Corps to allocate annually a minimum amount of funds for the Great Lakes-Seaway.⁶³ However, individual Soo Lock asset renewal projects must compete for funding with other Army Corps projects across the country at the district, division, and headquarters level, based in part on a project’s risk rating. In contrast, the U.S. Seaway Corporation is a much smaller organization and directly allocates its funding to projects based on its own condition assessments.

⁶¹Pub. L. No. 111-5, 123 Stat. 155.

⁶²Pub. L. No. 113-121 § 2102, 128 Stat. 1273 (codified at 33 U.S.C. § 2238 (d)(1)(B)(ii)).

⁶³Army Corps officials report that they requested and received \$57.6 million in additional construction funds in fiscal year 2018 for four asset renewal projects through a Major Rehabilitation Report. These projects received funds from the Construction account, whereas asset renewal projects are typically funded out of the Army Corps’ Operations and Maintenance appropriations account. Detroit District Army Corps officials noted they pursued the Major Rehabilitation Report in an attempt to fund some needed and costly asset renewal projects.

Figure 9: U.S. Army Corps of Engineers (Army Corps) and U.S. Saint Lawrence Seaway Corporation (U.S. Seaway Corporation) Funding Received for Asset Renewal Efforts, Fiscal Years 2008–2017 (in millions)



Source: GAO analysis of U.S. Army Corps and U.S. Seaway Corporation data. | GAO-18-610

The U.S. Seaway Corporation Has Established Goals and Measures for Asset Renewal Efforts but the Army Corps Lacks Goals and Measures for the Soo Locks

The U.S. Seaway Corporation has a lock performance goal and measure that officials use to monitor its asset renewal efforts, in accordance with government internal control standards, but the Army Corps does not have such a goal specific to the Soo locks. *Standards for Internal Control in the Federal Government*⁶⁴ states that agencies should define objectives clearly and in measurable terms so that performance toward achieving those objectives can be assessed. Similarly, *Leading Practices in Capital Decision-Making*⁶⁵ states that organizational goals should be integrated into the capital decision-making process and that agencies should use performance measures to evaluate results of capital projects to determine if goals have been met. As part of the Department of Transportation's annual performance reports, the U.S. Seaway Corporation reports its

⁶⁴GAO-14-704G.

⁶⁵GAO/AIMD-99-32.

annual progress toward its goal of maintaining 99 percent system availability of the U.S. portion of the Seaway during the navigation season. This measure includes times the system is unavailable for three key reasons: vessel incidents, weather, and lock outages. Of these reasons, the U.S. Seaway Corporation has the most direct control over lock outages. U.S. Seaway Corporation officials told us they use this information, particularly on lock outages, to assess the effect of its asset renewal efforts on lock performance, as part of its agency goal to reduce the risk of delays due to lock equipment failure.

The Army Corps has not established specific operational goals or metrics for the Soo locks that can be used to evaluate the outcomes of its asset renewal efforts. In its annual financial report, the Army Corps Civil Works program has a nationwide strategic goal to facilitate the transportation of commerce goods on the nation's coastal channels and inland waterways and a corresponding goal and measure for the number of instances where mechanically-driven failure at locks resulted in delays of more than a day or week. This national measure aggregates Army Corps locks across the country, including over 200 in the inland waterways such as the Mississippi River. However, this national goal and measure does not provide information on the operational performance of individual locks, including the Soo locks.

Detroit District Army Corps officials told us that they have not established operational goals or measures specific to the Soo Locks because the Army Corps' project approval process involves prioritization based on risk rather than operational performance. Specifically, these officials noted that asset renewal efforts are measured by improved risk scores, which indicate higher reliability and less likelihood of unscheduled outages. While this process allows the Army Corps to prioritize individual investment decisions according to risk, it does not define a specific measurable goal for the operational performance of the Soo Locks. As a result, the Army Corps lacks a key tool to assess whether the investments made in the locks have resulted in improved lock performance, such as reductions in outages and delays to its users. Furthermore, the Detroit District has access to information that could be used to develop measure performances for the Soo Locks—specifically the Lock Performance Monitoring System, which contains lock operations data such as scheduled and unscheduled outages. According to Detroit District officials, these data are used for the Army Corps' nationwide lock performance measure.

The Army Corps has previously noted the need for local lock performance goals and measures to improve asset management. In December 2006, the Great Lakes and Ohio River Division, which has the Soo locks in its jurisdiction, recommended in a 5-year plan the development of specific goals for the Great Lakes navigation system for use in prioritizing investments, but the plan has not been updated since then.⁶⁶ Furthermore, a 2013 Army Corps commissioned report on best practices in asset management recommended the development of key performance indicator target values to monitor the effectiveness of asset management.⁶⁷ Likewise a senior official in the Army Corps' Asset Management Program Office—which shares leading asset management practices across the Corps—stated that local and regional offices have the ability to develop local lock performance goals and measures to assess the local results. This official also noted the goals and measures to evaluate the progress of asset renewal efforts and lock performance would allow for greater transparency to stakeholders. Without goals and associated measures for the Soo locks, the Army Corps cannot link its asset renewal efforts to improved lock performance and cannot demonstrate the effect of these efforts to stakeholders.

Conclusion

The Great Lakes-Seaway serves as an essential transportation route linking U.S. manufacturing, agricultural, and other industries in the nation's interior to the global economy. Yet, this system faces various challenges that, according to stakeholders, pose risks to traditional and emerging uses that could limit the system's ability to enhance the region's economy. The U.S. Seaway Corporation's mission to improve the system's utilization and reliability provides it with a unique vantage point for assessing the cumulative risks that these challenges pose on the system's current and future utilization. Establishing a process for identifying, analyzing, and monitoring the system's risks would better enable the U.S. Seaway Corporation to design future actions that it, and other stakeholders, could take to address those risks. Similarly, the Army Corps' efforts to rehabilitate the Soo locks are critical to U.S. manufacturing and trade in the Great Lakes region. Regardless of the

⁶⁶See Army Corps Great Lakes and Ohio River Division, *Great Lakes Navigation System Five-Year Development Plan FY07-FY12*, December 2006. Army Corps officials noted the plan has not been updated because it is not currently used as a budgeting tool, and instead, as mentioned above, projects compete in part based on a project's risk rating.

⁶⁷See Institute for Water Resources, Army Corps, *Best Practices in Asset Management*, 2013-R-08, (Alexandria, Virginia: October 2013).

outcome of the decision on whether to build another Soo lock, the importance of the Poe lock remains, as indicated by the concerns raised by stakeholders regarding its condition. Given the criticality of the Poe lock and the more stable funding for asset renewal since 2014, it is important that the Army Corps assess these funds' potential effect on the Soo locks' performance. Without establishing goals and measures for the Soo locks, the Army Corps is not able to demonstrate whether the substantial investments made so far and planned in the future will improve the Soo locks' performance and by extension, the reliability of the Great Lakes navigation infrastructure.

Recommendations for Executive Action

We are making the following two recommendations:

The Administrator of the U.S. Seaway Corporation should establish a process to identify, analyze, and monitor risks to the system's use to inform future actions to address those risks. (Recommendation 1)

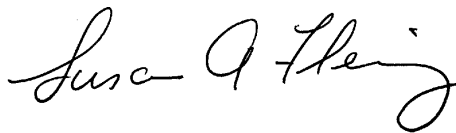
The Army Corps Director of Civil Works should, in coordination with the Commanders of the Great Lakes and Ohio River Division and the Detroit District, develop and adopt goals and measures to assess the performance of the Soo Locks and assess outcomes of asset renewal efforts. (Recommendation 2)

Agency Comments

We provided a draft of this product to the Departments of Defense, Transportation, and Homeland Security for comment. In comments, reproduced in appendixes III and IV, the Departments of Transportation and Defense concurred with our recommendations. All three departments also provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Transportation, the Secretary of Defense, the Secretary of Homeland Security, and other interested parties. In addition, this report is available at no charge on our website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or flemings@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix V.



Susan Fleming
Director, Physical Infrastructure Issues

Appendix I: Objectives, Scope, and Methodology

This report examines (1) how Great Lakes-St. Lawrence Seaway (Great Lakes-Seaway) shipping trends have changed since 1980 and what factors have shaped recent trends, (2) selected stakeholders' perspectives on challenges to using the Great Lakes-Seaway, and (3) to what extent the U.S. Army Corps of Engineers (Army Corps) and the Saint Lawrence Seaway Development Corporation (U.S. Seaway Corporation) have made progress on lock infrastructure renewal efforts and how the agencies measure performance of these efforts.

To understand shipping trends, we analyzed cargo traffic by tonnage for both the St. Lawrence Seaway (published jointly by Canada's St. Lawrence Seaway Management Corporation and the U.S. Seaway Corporation) and for domestic Great Lakes cargo traffic (from the Army Corps' Waterborne Commerce Statistics Center) from 1980 to 2016. Although the Seaway data represents all cargo traffic that travels on the St. Lawrence Seaway, we analyzed the Army Corps' domestic data, which accounts exclusively for traffic between U.S. ports on the Great Lakes system. As a result, some cargos that travel on the Great Lakes—such as between U.S. and Canadian ports or between Canadian ports—are not included, although such movements would be captured in the Seaway data to the extent they enter the Seaway. Although the Army Corps' data include information on Canadian and foreign cargo, we did not analyze or report this information because (1) of the limitation, which we confirmed with Army Corps officials, that the data exclude Great Lakes cargo movements between Canadian ports and (2) including this information would potentially double-count trips that also entered the St. Lawrence Seaway. We selected the 1980 to 2016 timeframe because it provides a sufficient timeframe to describe long-term trends using consistently collected data from both sources and 2016 is the most recent year for which both sources have published data. We also analyzed cargo trends for the top five commodities by tonnage from 2001 to 2016 for domestic Great Lakes and St. Lawrence Seaway traffic. We selected the years 2001 to 2016 to capture trends over the past approximately 15 years. The selected commodities represent the majority of cargo traffic for both sources. Specifically, the top five domestic Great Lakes commodities made up 96 percent of total cargo tonnage from 2001 to 2016, while the five commodities for the St. Lawrence Seaway represented 71 percent of total St. Lawrence Seaway cargo tonnage for the same time period. We assessed the reliability of the data by reviewing documentation and interviewing Army Corps and U.S. and Canadian Seaway Corporation officials and determined these data were sufficiently reliable for our purpose of describing trends. To describe factors that have shaped recent trends, we reviewed available government and industry reports, such as

the 2007 Great Lakes-Seaway study, the 2013 U.S. Department of Transportation Maritime Administration's *Status of the U.S.-Flag Great Lakes Water Transportation Industry*, and the 2016 Conference of Great Lakes and St. Lawrence Governors and Premiers' *Strategy for the Great Lakes-St. Lawrence River Maritime Transportation System*.

To understand factors affecting recent trends and challenges to using the system, we interviewed 24 stakeholders representing a range of traditional and emerging system users and experts. We interviewed representatives from three carriers that transport goods on the system and three associations that represent current U.S., Canadian, and foreign vessel traffic: Interlake Steamship Company, FedNav, Spliethoff, Lake Carriers Association, Chamber of Marine Commerce, and the Shipping Federation of Canada. We interviewed four Great Lake ports stakeholders, including three ports that represent a range of cargo levels and mix of cargos—Port of Duluth, Port of Cleveland, and Port of Indiana, Burns Harbor—and their association, the American Great Lake Ports Association. We interviewed six stakeholders that represent traditional or emerging shipping uses (e.g., cruises and containers) on the system: Cleveland-Cliffs Inc.; Tata Steel; CHS Inc.; General Motors; American Iron and Steel Institute; and the Great Lakes Cruising Coalition. We interviewed two maritime experts and a freight forwarder which helps arrange shipping logistics: Dr. Walter Kemmsies, Martin Associates, and Midwest Transatlantic Lines. Lastly, we interviewed representatives from five Great-Lakes Seaway region and maritime stakeholder groups: Conference of Great Lakes and St. Lawrence Governors and Premiers, Great Lakes Commission, Council of the Great Lakes Region, Committee on the Marine Transportation System, and the American Pilots' Association. We grouped the challenges identified by stakeholders based on whether challenges affect traditional use of the system or emerging use of the system. Although the results are non-generalizable, stakeholders were selected to represent a range of known perspectives. To better understand the context of these challenges, we interviewed officials from the Army Corps, U.S. Seaway Corporation, U.S. Coast Guard, and Customs and Border Protection.

To understand the agencies' progress on asset renewal efforts and how they measure performance of these efforts, we analyzed available information on projects, status, and estimated cost from both agencies. To assess the agencies' asset renewal progress we reviewed the Army Corps' most recent asset renewal plan from 2016 with updates provided by the Army Corps in May 2018. Likewise, we analyzed information provided by U.S. Seaway Corporation officials in March 2018 on project-

by-project expenditures from 2009 to 2016 and cost estimates from 2017 to 2023. Although we describe the agencies' cost estimates for their asset renewal efforts, it was beyond the scope of this engagement to check these cost estimates for accuracy and completeness. Likewise, although we describe the agencies' processes for selecting projects for funding, we did not verify these processes by, for example, selecting projects and ensuring the selection met the agencies' established procedures for selection. We reviewed U.S. Seaway Corporation and Army Corps relevant reports, available asset renewal plans, and documentation related to program goals and performance measures, such as annual financial and performance reports, from 2007 through 2018. We also visited the Soo locks at Sault Ste. Marie, Michigan, and the Seaway locks at Massena, New York, in summer 2017 and interviewed officials from both agencies. For example, within the Army Corps we interviewed officials from the Detroit District, headquarters' navigation and Asset Management Program offices, the Inland Navigation Design Center, and the Institute for Water Resources. We compared agencies' efforts to GAO's *Standards for Internal Control in the Federal Government* and to *Leading Practices in Capital Decision-Making*. Although the Great Lakes-Seaway system is binational, we are not evaluating the Canadian agencies, although we did interview officials from the Canadian St. Lawrence Seaway Management Corporation to understand their process for asset renewal.

Appendix II: List of Asset Renewal Projects

The Army Corps information below is based on the most recent asset renewal plan report from 2016 for the Soo locks, with updates provided by the Army Corps in May 2018. The U.S. Seaway Corporation information includes project-by-project expenditures for fiscal years 2009 through 2016 and cost estimates for work from fiscal years 2017 through 2023 provided by U.S. Seaway Corporation officials in March 2018. To align projects between the two agencies, we removed from the U.S. Seaway Corporation list: a dredging project (since the Army Corps information does not include dredging), one Seaway International Bridge project that lacked an associated cost estimate, and discontinued projects. It was beyond the scope of this review to check these cost estimates for accuracy and completeness.

Table 2: U.S. Army Corps' Asset Renewal Projects for the Soo Locks (Note: Costs Are Estimates)

Project	Lock(s) or other facility	Status	Cost estimate
Replace compressed air system, which is used to prevent ice	Poe and MacArthur	Completed	\$7,861,000
Replace lock utility lines and steam system, used for de-icing	Poe and MacArthur	Completed	\$3,000,000
Fabrication of second set of stoplogs to allow for full dewatering of the lock	Poe	Completed	\$4,273,000
Upgrade electrical infrastructure	Poe	Completed	\$5,600,000
Replacement of quoin and miter blocks that help transfer load from the gate to the lock wall	Poe	Completed	\$3,300,000
Replace gate latches to protect the miter gates	Poe	Completed	\$600,000
Replace hydraulics system	Poe	Completed	\$5,000,000
Modernize electrical infrastructure	MacArthur	Completed	\$8,500,000
Replace embedded gate anchorages	MacArthur	Completed	\$5,800,000
Replace fill/empty valve bulkheads	MacArthur	Completed	\$1,000,000
Replace bevel gears that help move the miter gates	MacArthur	Completed	\$500,000
Replace miter gate coating (gate 6)	MacArthur	Completed	\$500,000
Repair crib dam for power plant	Hydropower	Completed	\$2,466,000
Replace transformer in power plant	Hydropower	Completed	\$1,000,000
Replace switchgear for power plant	Hydropower	Completed	\$750,000
Replace protective relays for power plant	Hydropower	Completed	\$750,000
Replace switchgear assembly B, to assist with de-watering	Facilities	Completed	\$1,045,000
Replace sluice gate valves for Poe and Davis pump well which are used to dewater the locks	Facilities	Completed	\$1,350,000
Repair west center pier, which forms the north wall of the approach channel (outer portion of the wall)	Poe and MacArthur	Ongoing	\$9,050,000
Replace lock gate anchorage links	Poe and MacArthur	Ongoing	\$3,069,000
Fabrication of new stoplog lifting beams	Poe and MacArthur	Ongoing	\$900,000
Replace embedded gate anchorages	Poe	Ongoing	\$12,900,000

Appendix II: List of Asset Renewal Projects

Project	Lock(s) or other facility	Status	Cost estimate
Refurbish stoplogs, which allow for gate and chamber maintenance	MacArthur	Ongoing	\$2,250,000
Modernize steamplant, which supports de-icing	Facilities	Ongoing ^a	\$5,800,000
Repair west center pier, which forms the north wall of the approach channel (inner portion of wall closest to lock chamber)	Poe and MacArthur	Remaining	\$82,560,000 ^b
Rehabilitation of Davis pump well which is used to dewater locks for winter maintenance	Poe and MacArthur	Remaining	\$22,700,000
Rehabilitate ship arrestor booms that are designed to protect miter gates from vessel impact	Poe	Remaining	\$4,080,000
Gate 1 coating/ weld repairs (upstream end of lock)	Poe	Remaining	\$6,300,000
Rehabilitate fill/ empty valve bulkheads	Poe	Remaining	\$600,000
Rehabilitate fill/ empty valves	Poe	Remaining	\$3,200,000
New miter gate replacement (spare) for upstream end	Poe	Remaining	\$11,100,000
Rehabilitation of Poe pump well used to dewater Poe lock for winter maintenance	Poe	Remaining	\$17,700,000
Fabrication of replacement stoplogs (replacement for originals from initial Poe Lock construction)	Poe	Remaining	\$6,100,000
Gate 2 coating/ weld repairs	Poe	Remaining	\$4,600,000
Gate 4 coating/ weld repairs	Poe	Remaining	\$4,700,000
Stoplog recess repairs	Poe	Remaining	\$800,000
Rehabilitate ship arrestor booms that are designed to protect miter gates	MacArthur	Remaining	\$3,900,000
Rehabilitate lock fill/ empty valve machinery	MacArthur	Remaining	\$4,800,000
Rehabilitate gate skin plate and replace gate coating	MacArthur	Remaining	\$6,100,000
Repair southwest pier, which serves as south upstream approach wall	MacArthur	Remaining	\$9,500,000
Reinforce piers mooring bollards along approach wall (Southwest Pier)	MacArthur	Remaining	\$1,600,000
Rehabilitate center dike and relocate feeder cable for power plant	Hydropower/Facility	Remaining	\$24,700,000
Replace heavy lift crane	Facilities	Remaining	\$6,500,000 ^c
Emergency dam system	Facilities	Remaining	\$1,800,000

Source: U.S. Army Corps of Engineers. | GAO-18-610

^aArmy Corps officials noted this project is ongoing in terms of design (not construction).

^bArmy Corps officials said if a new Poe-size lock is constructed, this project could be completed at a lower cost (\$7.45 million rather than \$82.56 million).

^cArmy Corps officials stated that this project's cost estimate needs to be further developed by the Army Corps.

Table 3: Saint Lawrence Seaway Development Corporation (U.S. Seaway Corporation) Asset Renewal Projects

Project	Lock(s) or other facility	Status^a	Total expenditures (FY 2009-2016)	Most recent cost estimates (FY 2017-2023)
Rehabilitate Downstream Miter Gates	Snell and Eisenhower	Completed	\$6,761,839	\$0
Rehabilitate Mooring Buttons, Pins, and Concrete Along Guidewalls and Guardwalls	Snell and Eisenhower	Completed	\$982,080	\$0
Culvert Valve Machinery - Upgrade to Hydraulic Operation	Snell and Eisenhower	Completed	\$9,125,053	\$100,000
Perform Structural Rehabilitation and Corrosion Prevention	Seaway International Bridge	Completed	\$8,783,585	\$0
Replace Roofs	Corporation Facilities	Completed	\$563,967	\$0
Replace Wire Ropes - Vertical Lift Gate	Eisenhower	Completed	\$865,789	\$0
Compressed Air Systems - Upgrade/Replace	Snell and Eisenhower	Completed	\$815,948	\$800,000
Upgrade/Replace Fire Alarm/Protection Systems	Corporation Facilities	Completed	\$8,155	\$500,000
Rehabilitate Upstream Miter Gates	Snell and Eisenhower	Completed	\$4,944,913	\$0
Snug Harbor - Rehabilitate Spare Gate Storage and Assembly Area		Completed	\$2,483,052	\$0
Upgrade/Replace Emergency Generators	Snell and Eisenhower	Completed	\$2,139,404	\$0
Miter Gates - Structural Rehabilitation	Snell and Eisenhower	Completed	\$6,591,929	\$0
Replace Elevator - Administration Building	Corporation Facilities	Completed	\$140,346	\$0
Replace Fuel Tanks -Maintenance Building	Corporation Facilities	Completed	\$184,200	\$0
Security Upgrades at Duty Free Store Property	Corporation Facilities	Completed	\$13,025	\$0
Install Lock Wall Guardrails	Snell and Eisenhower	Completed	\$563,104	\$0
Replace Fendering on Approach Walls	Snell and Eisenhower	Ongoing	\$438,556	\$310,000
Rehabilitate Winter Maintenance Lock Covers	Snell and Eisenhower	Ongoing	\$180,621	\$0
Culvert Valves - Replace with Single Skin Valves	Snell and Eisenhower	Ongoing	\$1,932,640	\$0
Floating Navigational Aids - Replace		Ongoing	\$340,975	\$1,080,000
Replace Heavy and Light Equipment, Maintenance Vehicles and Shop Equipment	Corporation Equipment	Ongoing	\$2,753,309	\$3,070,000
Upgrade Power Supply Infrastructure from Moses-Saunders Dam to Both Locks and Adjacent Facilities	Snell and Eisenhower	Ongoing	\$429,340	\$610,000
Fixed Navigational Aids - Rehabilitate		Ongoing	\$114,128	\$350,000
Upgrade/Replace Floating Plant/Tugs	Corporation Equipment	Ongoing	\$8,016,083	\$15,100,000

Appendix II: List of Asset Renewal Projects

Project	Lock(s) or other facility	Status^a	Total expenditures (FY 2009-2016)	Most recent cost estimates (FY 2017-2023)
Replace Paving and Drainage Infrastructure	Corporation Facilities	Ongoing	\$1,914,977	\$4,000,000
Rehabilitate Highway Tunnel	Eisenhower Lock	Ongoing	\$1,564,642	\$1,000,000
Upgrade GPS/AIS/TMS	Corporation Technologies	Ongoing	\$190,470	\$400,000
Upgrade Electrical Distribution Equipment	Corporation Facilities	Ongoing	\$1,110,820	\$1,650,000
Upgrade Lock Status/Controls	Snell and Eisenhower	Ongoing	\$487,158	\$250,000
Install Vessel Self Spotting Equipment	Snell and Eisenhower	Ongoing	\$288,924	\$300,000
Install Hands-Free Mooring System	Snell and Eisenhower	Ongoing	\$7,166,059	\$11,100,000
Structural Repair - Grout Leaks in Galleries and Recesses	Snell and Eisenhower	Ongoing	\$37,561	\$550,000
Upgrade Storage for Lock Spare Parts	Corporation Facilities	Ongoing	\$1,566,362	\$800,000
Replace Windows and Doors and Repair Building Facades	Corporation Facilities	Ongoing	\$49,361	\$325,000
Rehabilitate Walls, Sills and Culverts Concrete	Eisenhower	Ongoing	\$203,113	\$8,050,000
Upgrade Drainage Infrastructure in Galleries and Recesses	Snell and Eisenhower	Ongoing	\$308,827	\$450,000
Improve Ice Control	Snell and Eisenhower	Ongoing	\$7,462	\$1,100,000
Upgrade Outdated Equipment for Dewatering Pumps	Snell and Eisenhower	Ongoing	\$256,988	\$50,000
Install Ice Flushing System	Snell	Ongoing	\$13,426,722	\$2,500,000
Upgrade/Replace Miter Gate Machinery	Snell and Eisenhower	Ongoing	\$5,289,869	\$850,000
Upgrade Physical Security to Meet Requirements	Corporation Facilities	Ongoing	\$424,732	\$0
Eisenhower Lock Visitors' Center - Replace	Corporation Facilities	Ongoing	\$1,088,693	\$5,000,000
Upgrade Network Security	Corporation Technologies	Ongoing	\$167,977	\$200,000
Upgrades to Meet Sustainability and Energy Goals	Corporation Facilities	Ongoing	\$146,836	\$200,000
Communications Improvements	Corporation Facilities	Ongoing	\$32,996	\$200,000
Improve Access to and Rehabilitate Machinery in Crossovers and Recesses	Snell and Eisenhower	Ongoing	\$716,448	\$600,000
Replace Recess Covers on Lock Walls	Snell and Eisenhower	Ongoing	\$13,732	\$170,000
Rehabilitate Walls, Sills and Culverts Concrete	Snell	Not Started	\$0	\$5,500,000
Upgrade Ice Flushing System	Eisenhower	Not Started	\$0	\$2,600,000
Rehabilitate Vessel Mooring Cells		Not Started	\$0	\$750,000
Replace Diffusers	Eisenhower	Not Started	\$0	\$4,000,000
Upgrade/Replace Ship Arrestor Machinery	Snell and Eisenhower	Not Started	\$0	\$2,000,000
Rehabilitate Flow Control Dikes		Not Started	\$0	\$250,000

Appendix II: List of Asset Renewal Projects

Project	Lock(s) or other facility	Status ^a	Total expenditures (FY 2009-2016)	Most recent cost estimates (FY 2017-2023)
Rehabilitate Guidewall Extensions	Snell and Eisenhower	Not Started	\$0	\$800,000
Vertical Lift Gate - Structural Rehabilitation	Eisenhower	Not Started	\$0	\$2,000,000
Rehabilitate Stiffleg Derricks	Snell and Eisenhower	Not Started	\$0	\$1,000,000
Replace Diffusers	Snell	Not Started	\$0	\$4,000,000
Install/Upgrade Air Curtains	Snell and Eisenhower	Not Started	\$0	\$4,000,000
Install Electric Pleasure Craft Toll Collection Facility	Snell and Eisenhower	Not Started	\$0	\$100,000
Upgrade Lock Structures Maintenance Building	Corporation Facilities	Not Started	\$0	\$150,000
Repair/Replace Security Fencing	Corporation Facilities	Not Started	\$0	\$500,000
Facility and Underground Utilities Improvements	Corporation Facilities	Not Started	\$0	\$200,000
Stormwater Upgrades	Corporation Facilities	Not Started	\$0	\$125,000
Rehabilitate Building	Corporation Facilities	Not Started	\$0	\$1,000,000
Install Vehicle Corrosion Prevention Facility	Maintenance Facility	Not Started	\$0	\$250,000
Upgrade Waste Storage and Lead Decontamination Rooms	Maintenance Facility	Not Started	\$0	\$25,000
Upgrade Telephone System	Corporation Facilities	Not Started	\$0	\$30,000
Upgrade Weather Stations	Corporation Facilities	Not Started	\$0	\$50,000
Renewable Energy Project	Corporation Facilities	Not Started	\$0	\$2,000,000

Source: Saint Lawrence Seaway Development Corporation | GAO-18-610

^aU.S. Seaway Corporation officials noted that many projects listed as “completed” will require additional investment in the future, particularly after the 2023 time horizon denoted in this table.

Appendix III: Comments from the Department of Transportation



U.S. Department
of Transportation
Office of the Secretary
of Transportation

Assistant Secretary
for Administration

AUG 01 2018

1200 New Jersey Avenue, SE
Washington, DC 20590

Ms. Susan A. Fleming
Director, Physical Infrastructure Issues
U.S. Government Accountability Office (GAO)
441 G Street, NW
Washington, DC 20548

Dear Ms. Fleming:

The Saint Lawrence Seaway Development Corporation (SLSDC) is responsible for the operations and maintenance of the U.S. portion of the binational St. Lawrence Seaway. Since the waterway's opening in 1959, the SLSDC has provided safe, efficient, and secure passage of commercial vessels through the Seaway, maintaining a 99 percent reliability rate. Additionally, SLSDC's operations directly impact 33,000 U.S. jobs with \$4.7 billion in annual business revenue, \$2.4 billion in annual personal income, and \$1.1 billion in tax revenues.

In recent years, the SLSDC has taken the following actions to ensure safety, maintain reliability, address stakeholder challenges, and mitigate risk:

- Established a Capital Asset Renewal Program to identify and address Seaway infrastructure modernization and improvements.
- Renewed its International Standards Organization (ISO) certification to ensure that SLSDC business processes are effectively followed and managed, and customer concerns are addressed.
- Inspected all foreign-flag vessels on their first transit into the Seaway each year to address and reduce safety and environmental risks.

Upon review of GAO's draft report, we concur with the recommendation to establish a process to identify, analyze, and monitor risks to system use. We will provide a detailed response to the recommendation within 60 days of the final report's issuance.

We appreciate the opportunity to respond to the draft report. Please contact Madeline M. Chulumovich, Director, Audit Relations and Program Improvement, at (202) 366-6512 with any questions or if you would like to obtain additional details.

Sincerely,

Keith Washington
Deputy Assistant Secretary for Administration

Appendix IV: Comments from the Department of Defense



DEPARTMENT OF THE ARMY
OFFICE OF THE ASSISTANT SECRETARY
CIVIL WORKS
108 ARMY PENTAGON
WASHINGTON DC 20310-0108

AUG - 8 2018

Ms. Susan Fleming
Director
Physical Infrastructure
U.S. Government Accountability Office
441 G Street, NW
Washington, D.C. 20548

Dear Ms. Fleming:

This is the Department of Defense (DoD) response to the GAO Draft Report, GAO-18-610, "GREAT LAKES-ST. LAWRENCE SEAWAY: Assessing Risks and Measuring Performance Could Improve Maritime Transportation," dated September 2018 (GAO Code 102125).

The DoD concurs with comment to the recommendation in the GAO report. Specifics regarding our planned efforts are listed in Enclosure 1. Enclosure 2 is DoD's technical comments to the subject report. The DoD appreciates this opportunity to review the draft report. My point of contact is Mr. Theodore Kerr who can be reached at theodore.e.kerr.civ@mail.mil and 703-697-6985.

Sincerely,


Joseph P. Bentz
Deputy Assistant Secretary of the Army
(Management and Budget)

Encls

ENCLOSURE 1

**GAO DRAFT REPORT DATED SEPTEMBER 2018
GAO-18-610 (GAO CODE 102125)**

**“GREAT LAKES-ST. LAWRENCE SEAWAY: ASSESSING RISKS AND MEASURING
PERFORMANCE COULD IMPROVE MARITIME TRANSPORTATION”**

**DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATION**

RECOMMENDATION 2: The GAO recommends that the Army Corps Director of Civils Works, should, in coordination with Commanders of the Great Lakes and Ohio River Division and the Detroit District, develop and adopt goals and measures to assess the performance of the Soo Locks and assess outcomes of asset renewal efforts.

DoD RESPONSE: Concur, with comment. The Assistant Secretary of the Army (Civil Works) will direct the U.S. Army Corps of Engineers (USACE) Director of Civil Works to develop and adopt goals and measures to assess the performance of the Soo Locks and assess outcomes of asset renewal efforts.

The DoD concurs that adopting goals and measures to assess lock performance and assessing outcomes of asset renewal efforts could provide information critical for future risk reduction and investment strategies.

Headquarters USACE, in coordination with the Great Lakes and Ohio River Division, will coordinate actions to develop and adopt goals and measures to assess performance of the Soo Locks and outcomes of asset renewal efforts using the following methodology:

- a) Utilize a regional condition assessment team and a Detroit District Operations team to assess, review, evaluate, and make recommendations regarding infrastructure condition, risks, reliability, rehabilitation or improvements; and
- b) Use condition indices and reliability metrics such as scheduled and unscheduled outages, lock gate cycle times, lock fill and empty times, and other measures related to condition life cycle expectancy of lock components.

The next scheduled condition assessment inspection is scheduled for 2019. Any recommendations regarding infrastructure condition assessments, improvements, reliability assessments, or changes to National, regional, or local metrics identified will be incorporated and reported in the inspection report.

ENCLOSURE 2

**GAO DRAFT REPORT DATED SEPTEMBER 2018
GAO-18-610 (GAO CODE 102125)**

**“GREAT LAKES-ST. LAWRENCE SEAWAY: ASSESSING RISKS AND MEASURING
PERFORMANCE COULD IMPROVE MARITIME TRANSPORTATION”**

**DEPARTMENT OF DEFENSE TECHNICAL COMMENTS
TO THE GAO DRAFT REPORT**

GENERAL COMMENTS:

The primary take away in the GAO draft report is that U.S. Army Corps of Engineers (USACE) has not developed goals and measures to assess its Asset Renewal results. To date, the projects that have been accomplished under Asset Renewal all involved features that had failed, were failing, in need of exigent replacement/rehabilitation based on condition assessments, or deemed a significant safety hazard. USACE is authorized to operate and maintain the St. Mary's River Multi-Purpose Project (Soo Locks); as such, each Asset Renewal project accomplished at the Soo Locks was necessary to maintain service to the navigation industry. Modernization was not a focus of Asset Renewal at the Soo Locks. Modernization was undertaken only where necessary to effect compliance with safety and operational regulations; for example, electrical power and controls to reduce electrical hazards to operators and the risk of gate failure through installation of electrical interlocks.

The Headquarters USACE and the Great Lakes and Ohio River Division have a well-established Asset Management Program which annually, through use of a regional condition assessment team and/or a formal District Operations team, assesses, reviews, evaluates, and makes recommendations based on infrastructure conditions, risks, reliability, rehabilitation or improvement metrics. Condition indices are indicated based on current conditions and, when improvement or rehabilitations are affected, indices are updated to reflect the improvement in reliability. National metrics indicating system reliability are scheduled and unscheduled outages. This metric is applicable to all navigation systems and is not specific to navigation locks. The National metrics do measure lock gate cycles and lock fill and empty times, which are indicators of usage and directly related to the condition and life cycle expectancy of the lock components.

The Army's budgeting process is based on buying down risk using these asset management program principles. This is just one method used to measure the performance and effectiveness of each program/project. The goal is not to fix as fails, but be proactive and thus prevent significant outages that would then be reduced once a failed component is fixed. Prudent management of assets leads to repair/replace prior to failure, as determined by condition assessment and risks. Risk reduction is just one of the metrics used to define progress.

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contacts

Susan A. Fleming, (202) 512-2834 or FlemingS@gao.gov

Staff Acknowledgments

In addition to the contact named above, Matt Barranca (Assistant Director), Emily Larson (Analyst in Charge), Amy Abramowitz, Melissa Bodeau, Michelle Everett, Aaron Gluck, David Hooper, Alyssa Hundrup, SaraAnn Moessbauer, Joshua Ormond, and Shane Spencer made key contributions to this report.

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